RAILROAD GAZETTE

SATURDAY, APRIL 27, 1872.

Description of the Method of Founding the Piers for the Bridge Over the Missouri River at St. Joseph, Missouri.

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[Prepared for the Civil Engineers' Club of the Northwest, and read at the meeting, April 8, 1872.]

A bridge is now being constructed over the Missouri River at St. Joseph, Mo. The work is under the general direction of Col. E. D. Mason, as Chief Engineer, the Detroit Bridge and Iron Works of Detroit, Mich., being the contractor for the entire job.

The structure when complete will consist, as at present designed, of three fixed spans of 300 feet each, and one pivot draw-span of 400 feet, making a total length of 1,300 feet. The superstructure will be of iron throughout, with floor arranged for both railway and highway traffic. The substructure consists of piers of masonry sunk to the bed rock.

The object of the present paper is to describe the plan of the ordinary river piers and the method adopted for sinking them.

The necessity of placing the piers fairly upon the bed rock is sufficiently apparent to every one at all familiar with the character of the Missouri River.

The difference in elevation between high and low water at St. Joseph is about 22 feet. Borings on the line of the bridge show the bed rock to lie quite uniformly level at a depth of about 67 feet below high water, or say 45 feet below low-water line. During the stage of ordinary low water, the main channel of the river at the bridge site has, during the past season, hugged the east bank. Here for a width of say 400 feet the water is from 15 to 25 feet deep, running with a velocity of about four miles per hour. West of this it shoals rapidly up until the sandy bottom appears. The depth of water at the different piers as located has been during the past six months about as follows:

Pier No.	I., east abutment	on shore.
"	II., draw pier	say 25 feet.
"	III	" 15 "
"	IV	" 6 "
"	V	" 3 "
"	VI., west abutment	" on the bar.

It is perhaps unnecessary to say that the above only indicates the general average, for the bed of the river is changing constantly—the only certainty being uncertainty—the only stability being utter instability. The Missouri is a very *cat* among rivers—sly, treacherous, false, cruel. The only way to treat it is always to suspect it; always to be armed and vigilant against it.

Operations were begun on the west side of the river. A large and convenient yard for stone, timber, etc., was provided and liberally arranged with tracks, travelers, etc. From the west bank a pile bridge was built across the bar out into the river so far as to the location of Pier 4, a distance of about 750 feet. On this bridge tracks were laid so that all material could be carried in cars directly to the desired locality. The permanence of this bridge, during ordinary water, was secured by an extensive dyke of brush, earth and stone built out into the river just above it at such an angle as to deflect the current to the opposite side of the river and away from our works.

The general plan adopted for sinking the piers was that of undermining them by excavating the material, uniformly and intelligently, from beneath them, and thus lowering them by their own weight gradually and constantly to their desired final resting-place. Workmen were to be continually operating beneath them, the possibility of their presence there being assured by an air-pressure which should entirely force out the water from a chamber at the base of the pier.

This, then, indicated the general form of the bottom of the pier. It should be an inverted caisson, inclosing an open space or chamber sufficiently large for all the operations of the workmen.

The caisson for Pier No. 4 was constructed as follows, this being one of the ordinary sized river piers, which are 9 feet wide and 20 feet long under the coping at the bridge seat:

The exterior dimensions of the caisson at the bottom are 24 feet wide and 56 feet long, with rectangular corners. The sides and ends batter from the bottom toward each other in the ratio of one horizontal to twelve vertical. The caisson is constructed of 12x12 in. hard-wood timber throughout, and is divided into two parts—the caisson proper, being that part which incloses the inner working chamber, and the grillage or platform of timber interposed between the roof of this chamber and the bottom of the masonry. The caisson proper is say thirteen feet high and the grillage seven feet high, making a total height of 20 feet from the bottom of the caisson to the bottom of the masonry.

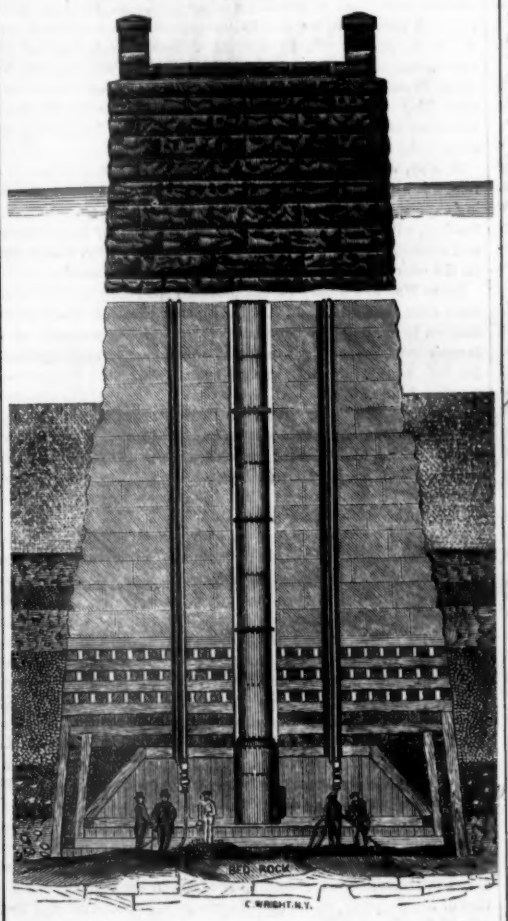
The caisson proper consists, first, of an outer course or skin of timbers placed side by side vertically; second, an intermediate course of timbers placed side by side horizontally; and third, an inner course of timbers placed side by side vertically. Thus the walls of the caisson are of solid timber three feet thick. The bottom of the inner course stops one foot short of the bottom of the intermediate course, while that in its turn stops one foot short of the bottom of the exterior course. One foot above the bottom of the inner course is placed a longitudinal timber girt, running entirely around the interior walls of the caisson. On this girt rest the ends of a continuous course of inclined timbers, sloping upward and inward at an angle of about forty-five degrees, and connected together at their tops by a continuous course of straining beams forming the roof of the chamber.

Thus it will be seen that the inclosed space at the base of the caisson is a floorless chamber about 22 feet wide and 54 feet long at the bottom, sloping up on all sides, until at the top it is reduced to a width of five feet and a length of 37 feet, the height being about nine feet. Running across this chamber at the level of the horizontal girt, about four feet from the bottom and at intervals of about eight feet, are timber struts and iron tie-rods, so arranged as to be capable of adjustment within the chamber.

The triangular space all around the caisson, between the exterior 3-feet walls and the sloping interior rafters, is filled with concrete carefully packed. Over all, resting upon and framed into the exterior walls and the straining beams and thoroughly bedded in the concrete, are placed three solid horizontal courses of timber, alternating in direction, thus making the roof of the chamber four feet of solid timber in thickness. Upon the top of this is the grillage, a system of seven horizontal courses of timber, each course laid at right angles with the one below it. These timbers in each course are spaced six inches apart, except the final or top course, which is solid. The grillage and the caisson together make up a total height as before stated of 20 feet.

While the caisson proper is, as above described, rectangular in horizontal section, the grillage is gradually drawn in, so that at the top it corresponds with the general shape of the masonry of the pier, which shows a curve starting at each end.

All joints and beds in the timber work are carefully and accurately fitted, great pains being taken with the joiner work; and



the whole is very securely and thoroughly bolted together, forming as far as possible a single, solid, stiff and homogeneous mass, capable of resisting strains in every direction.

The interior of the air chamber is very carefully caulked, so as to be as far as practicable absolutely air-tight.

The peculiar arrangement of the bottom bearing surface will be observed. The exterior course of timber descends the lowest, and so exposes for the cutting edge an area equal to the entire perimeter of the bottom of the caisson, and one foot wide. After this is buried one foot in the sand, another bearing surface comes into use, being the bottom of the intermediate course of timber; and after this in its turn has descended one foot, the bottom of the third or inner course of timber is ready for service; and, again, after another foot comes the horizontal girt. Thus the amount of bearing surface to be brought into requisition is entirely at the option of the workmen in the caisson. Should the material be soft and the caisson descend too rapidly under the accumulating weight of the masonry, the more it descends the broader becomes the area of support, and so the difficulty remedies itself. Should the material be hard and obdurate, or should snags or other obstructions be met with, the exterior cutting edge itself can be exposed, or, if necessary, the men can work entirely under it and so get at and remove the obstruction. Should the material be unequal, one side soft and the other side hard, the bearing surface on the former can be increased, and on the latter diminished, at will.

Hanging from the middle of the roof of the air-chamber is the air-lock, a hollow, closed cylinder of plate iron four feet in diameter and seven feet long. In one side is a door opening outward into the air-chamber, and in the top is another door, opening inward into the air-lock. From the top of the air-lock ascends the air-shaft, an open cylinder of plate iron three feet in diameter, reaching to the upper air, a suitable hole being left for its passage through the roof of the caisson, the grillage and the masonry. An iron ladder allows easy access through the shaft to the air-lock.

Through the roof of the caisson, the grillage and the stone work, pass the necessary air and water pipes connecting the air-chamber with the pumping machinery outside.

The caisson is built *in situ*, and when done is lowered down until it reaches the sandy bottom. Air is now pumped into the chamber, which gradually displaces the water, driving it out under the bottom until it is entirely full of air and empty of water. The workmen can then descend the air-shaft into the air-lock, which is large enough to hold six men at one time. Closing the door above their heads communicating with the air-shaft, a cock is opened which admits into the air-lock the compressed air from the air-chamber; until presently, when the pressure in the air-lock is equal to that in the air-chamber, the door connecting the two can be opened, and the men step through into the chamber upon the sandy bed of the river. The passage out is, of course, by reversing the process.

A small pipe leads from the air-chamber up through the air-shaft, at the top of which is an ordinary steam-whistle. The compressed air from the chamber, when admitted into this pipe, blows the whistle; and by this means a complete and easily understood system of signals is arranged between the men within and without the chamber.

And now begins the work of settling the mass. The material in the chamber and under the bearing surfaces of the caisson must be excavated and removed. As this is done, the pier gradually and certainly descends by its own gravity.

Formerly, and still in many places, this work of excavation was done by hand, the sand being packed into bags or buckets and hoisted laboriously through the air-lock. This process, while it may answer for small pipes or cylinders, is too slow and tedious for such large caissons. The cubic contents of a mass the size of the bottom of one of the ordinary river piers at St. Joseph, reaching from the rock up to the water line, is not less than 2,200 cubic yards. All this material is to be removed that its former position may be occupied by the pier. In addition to this, large quantities of sand from without the chamber are often sucked into it by slides under the cutting edge, and must be removed. Doubtless in practice not less than 3,500 cubic yards, and very likely more, must be excavated to settle one of our piers. To move this mass, raising it an average of say 40 feet in height, the inefficiency of bags and buckets hoisted through the air-lock is palpable.

We use for this work the sand-pump, as devised and adopted by Capt. James B. Eads for his great work, the St. Louis Bridge. I desire here to express my acknowledgments to this eminent and successful engineer for the warm friendly interest he has taken in our work at St. Joseph. The valuable results of his extended experience at St. Louis have been freely communicated and his advice has been of much service.

The sand-pump above referred to is somewhat similar in its mode of action to the well-known Giffard injector. Its general description and *modus operandi* with us are as follows:

On a boat or platform near the pier is placed one of the largest-sized Cameron water pumps. This is a direct acting engine with a steam cylinder 18 inches in diameter, and a water cylinder 12 inches in diameter—both 36 inches stroke. This, running at a speed of 20 full strokes per minute, delivers water at the rate of 760 gallons per minute. The water thus delivered is carried through a 5-inch pipe down into the air chamber, whence it is returned through a 3-inch pipe enlarged in its upper portion to 4 inches, and so discharged over the top of the pier. At the point of discharge into the smaller pipe and within the air chamber, all the water passes through an annular opening about 2½ inches in diameter and perhaps ¼ inch wide. It is evident that to pass so much water as is delivered by the pump, a sectional area of 12½ square inches through a 4-inch pipe, it must move with great velocity. But at the point where it is forced through this annular opening (a sectional area of not to exceed one square inch) its velocity must be enormous. Indeed, the struggle of the water to squeeze itself through this narrow passage way produces a pressure of the pump and in the pipes of about 150 pounds per square inch. The interior space of this annular opening is the upper end of a suction pipe, in which it is evident that the velocity of the water must create an almost perfect vacuum. The other end of the flexible suction hose is held to the sand, which is stirred up and moistened by a jet of water directed against it from a nozzle in the hands of one of the workmen. The power of suction is of course increased to the full extent of the air pressure in the chamber; and the result of the combined action of the powerful water pump and the air pressure is a constant and, in free working material, an astonishingly profuse discharge. Sand and gravel seem to absolutely melt and instantly disappear at the magic touch of the end of the suction pipe. The discharge from the escape pipe over the top of the pier is water so thick with sand or silt as to be almost viscid. I have never carefully gauged the capacity of one of these wonderful little instruments, but I presume that under favorable conditions it will deliver between 40 and 50 cubic yards of sand per hour.

At St. Joe, thus far, the great bulk of the material to be excavated has been sand or silt of such a nature as to work freely through the pumps. Still, we have met much clay and considerable deposits or medium-sized bowlders, which were necessarily hoisted through the air-lock.

In the ordinary small caissons, as above described, we place two sand pumps, either or both of which can be run. In the larger caissons we shall place four pumps, with a power to work three at a time if necessary. To drive three sand pumps satisfactorily requires an engine capacity of about 300 horse power.

Our pneumatic plant consists of six blowing cylinders driven by four steam engines, aggregating about 300 horse power, nominal, with a united capacity of discharging about 1,700 cubic feet of air per minute, under a pressure of say 20 pounds per square inch. Two blowing cylinders coupled together constitute a battery, and each battery can be and is worked independent of the others. Generally only one battery at a time is

required for a caisson—the others being run elsewhere or held in reserve.

To furnish steam for this machinery are required seven large flue boilers and one tubular boiler.

For derricks and the various other demands of the work there are in use six portable engines. Twelve considerable barges, with quite a fleet of small boats are engaged in the service.

The masonry is built upon the caisson as it descends, the top of the pier being always above water. Thus there is always ready a surplus of weight necessary to sink the pier. By reason of this surplus no exact estimate has been made for the co-efficient of the friction of the sand upon the sides. During the earlier stages of sinking and at small depths, the mass slowly and constantly descends as the material is excavated from beneath it. As greater depths are reached and the friction of the surrounding material upon the immense area becomes considerable, it moves with more reluctance. The process now is to remove the sand nearly or quite to the cutting edge and, in extreme cases, even below it; and then, after sounding carefully under all sides, to be sure that there is no concealed snag or other obstruction to the downward passage, the air pressure is relieved as far as may be necessary. Presently the mass seems to be a living thing. It groans, trembles, quivers, seems to shake itself free from its shackles and fairly lurches downward in a series of rapidly consecutive and convulsive spasms, until its descent is gradually stopped by the increased bearing surface at bottom brought into action by its own motion. Sometimes in this way it will go down two feet in as many minutes.

The work of sinking is prosecuted continuously. The caisson men are divided into three watches of eight hours each, until a depth of 35 feet or so is reached, when the increasing pressure renders it desirable to shorten the watch to six hours.

In free-working material we have frequently made 5½ feet, and occasionally even 7 feet in 24 hours. Our general daily average, however, will probably fall a little short of two feet.

The air-pressure, of course, varies with the depth of water, a column of water one foot high and one inch in section balancing somewhat less than one-half pound per square inch of pressure. The depth of the rock thus far has been about 46 feet below water surface, requiring a pressure above that of the ordinary atmosphere of about 20 pounds per square inch. No serious inconvenience has thus far been experienced by any who have been subjected to it.

When the bed-rock is fairly reached, a wall of concrete is built under all the bearing edges of the caisson. This wall is about six feet wide on the rock, and is brought up in layers and carefully and solidly rammed under all the bearing timbers up to and including the horizontal girt mentioned above in the description of the caisson. The air-lock, air-shaft and air-pipes are then removed, the operation of the sand-pumps reversed, and clean sand and gravel are pumped with great force into the chamber. The accompanying water, being lighter than the sand, is expelled through a pipe left for the purpose, and thus the chamber is filled compactly and thoroughly. In this way the entire horizontal area of the roof and of the sloping sides is made available for bearing surface. This is assumed to be as reliable a bearing as masonry itself, inasmuch as the concreting at the bottom of the caisson renders the escape of the sand impossible, even should the material surrounding the caisson be scoured out to the rock itself.

The sand pipes are then unscrewed and withdrawn, the openings for the various pipes and shafts filled up, and the pier finished.

The caisson for one of the ordinary piers for this bridge contains about 175,000 feet, board measure, of hard-wood timber, about nine tons of iron bolts, etc., and about 100 cubic yards of concrete in the hips and under the cutting edges. The pier proper contains about 1,000 cubic yards of masonry. From the bed rock to the bridge-seat of pier is about 77 feet.

The material through which the piers have passed is, as has been already mentioned, mainly fine sand or a species of silt peculiar to this river. Frequent pockets and often regular strata of stiff, hard clay (known in that country as "gumbo") have been met. Snags and drift are of frequent occurrence. At a depth of 40 feet pieces of brick and fragments of coal have been taken out, showing that in comparatively recent times the scour has reached that depth. The bed rock has been generally immediately overlaid with a deposit of from two to five feet of medium-sized bowlders mixed with very coarse sand. These bowlders are all thoroughly water-worn and rounded by attrition, and have evidently been brought from great distances at some remote period of the history of this region. They are of red and gray granites, schist, gneiss, conglomerate, trap, quartz. Many agates have been found, some amethysts, many small rubies, and many specimens—some fine ones—of gold-bearing quartz. The bed rock is a smooth, hard, whitish-gray limestone, overlaid with a broken shale of two or three inches in thickness, but underneath this very solid and reliable.

The water in the Missouri River is generally much discolored—indeed, fairly turbid—with the quantity of earth and sand held in solution. But the water found percolating through this deposit of bowlders over the bed rock is as pure and clear as that from any mountain spring. While ice at the surface was two feet thick, and the mercury often many degrees below zero, this water had a uniform temperature of 54 degrees.

This description, long as it is, would not be complete were I to neglect the expression of my satisfaction with the certainty, celerity and comparative economy of the pneumatic process, as adapted for deep-water foundations in localities similar to this. True, it requires a large, complete, powerful and very expensive plant; but, with that provided, one of these massive piers can be handled with an ease and a security that is unknown to any other system with which I am familiar. For instance, by an accident, one of our caissons was landed upon the sand two feet too far south and two feet too far east, but during the sinking we worked it back to its true position without difficulty. All through the severities of the past unexampled winter the work of sinking has gone forward almost without reference to the weather. When by reason of storm and cold men could not work out of doors, the labor in the warm, sheltered air chamber has been almost uninterrupted.

Before closing, it may not be entirely foreign to the subject to allude to the effort—the first that I know of on a large scale—that is being made in connection with this bridge to control the channel of the Missouri River. This is not embraced in the contract of the Detroit Bridge and Iron Works, but is being prosecuted by the company, directly under the charge of Colonel Mason, the Chief Engineer.

I hope that that accomplished and painstaking engineer and valued member of this club may find leisure soon to prepare for the information of the club a paper descriptive of his plans and of his very interesting experience in the work.

The Rockford, Rock Island & St. Louis Railroad.

Rockford, Rock Island & St. Louis is a name of bad omen in Germany, where its original managers borrowed money on the company's bonds for enough to construct and equip the road (after a fashion), and with a margin of the trifle of $10,000 per mile or so for profit. Shortly after the road was completed the company failed to pay the interest on its bonds, the earnings being very light, partly because it was in bad order and poorly equipped, and partly because the line runs at right angles with the current of traffic, and it cannot carry any considerable portion of the traffic of the country through which it runs in the direction it wants to go, unless by a more indirect and inconvenient route than is offered by other lines. At least it failed to meet its obligations, and the management was changed, and Mr. R. R. Cable, a wealthy resident of Rock Island, who had the reputation of not wasting any money in his own business, became President. He has given an account of his stewardship from May to the close of 1872, directed to the bondholders, which we find printed in a German paper, and from which we extract the following statements:

In May, when the present management came into power, the road was without credit, without earnings sufficient to meet working expenses, without sufficient rolling-stock, entirely without fencing, without shops for repairs and shelter for locomotives, and a floating debt of nearly $450,000, most of which was a lien on the company's property prior to the mortgage bonds.

From May to January (seven months) the receipts of the road were over $597,000, and the company realized from other sources (including the proceeds of the sale of material of a branch three miles long, which was abandoned as useless) about $60,000; so that the total receipts were $657,000. The necessary working expenses and the rental of the track of another company which it uses absorbed $417,000 (63½ per cent.), and the surplus was expended in reducing the floating debt, repairing the road, and providing the indispensable shops and engine-houses. Meanwhile the floating debt was increased by the auditing of old demands, yet by the end of November it had been reduced to about $300,000.

In order to fence the rest of the line, as is necessary for its economical working as well as in obedience to the law, $150,000 were required at the date of the report.

Although the President hoped for a considerable increase in the receipts, which, unlike those of most railroads, are likely to be heavier in winter than in summer (not having the competition of the Mississippi River in the former season), he announced that the payments of coupons due in August, 1871, and February, 1872, probably could not be paid in cash. As the road cannot be operated economically and cannot even do at all the business which is offered it without an increase in rolling stock and considerable other improvements, the President insists that a large part of the net earnings must be expended on the road; but in order that the bondholders may have some income from their investment, he proposes that one-half of the net receipts be reserved for them, the other half going toward the improvement of the property. For authority to adopt this policy he asked the bondholders, recognizing them, in the existing condition of the property, as the parties whose will should control the acts of the directors.

A meeting of the bondholders was held on the receipt of this communication from the President, and they passed resolutions declaring their confidence in the present management, expressing their desire that one-half of the net earnings after February 1 be devoted to the redemption of the coupons as they come due, and that the portion unpaid of these and the past-due coupons be redeemed in 5 per cent. certificates, to be paid out of the future net earnings as early as possible. They also recommend the stamping of the bonds of those who should agree to this arrangement, and the standing committee of the bondholders was authorized to appoint a trustee in America to represent their interests there, advise with the directors, examine the books and report.

Camden & Atlantic Railroad Report.

This company's railroad extends from Camden, opposite Philadelphia, southeast to the Atlantic coast at Atlantic City, N. J., 59 miles. The Philadelphia *Public Ledger* gives the following summary of the report for 1871:

The gross receipts of the road for the year 1871 were $364,500, and the operating expenses $184,120, a difference of $180,379. Of this excess $78,797 went to interest on the bonded debt, $49,265 to renewal for May's Landing road, $28,393 to increase of rolling stock, and $16,326 to construction, insurance, taxes, etc. The May's Landing branch road, about seven miles long, it is expected, will be ready for use early in the coming summer. The branch from Atco to Williamstown, about ten miles, is in course of construction, and will soon be completed. It is also in contemplation to make another branch road, some four miles, from White Horse to Blackwoodtown. These branch roads and the connection already formed with the Vineland road at Winslow are tributaries that must ultimately increase very materially the business of the main line of the Camden & Atlantic road. The company has purchased the Cooper's Point & Philadelphia Ferry Company's stock, boats and property of every character, for $82,800 in preferred stock at par, and propose to run the ferry under the charter of the railroad company. There were 29,797 more miles run and $30,056 more income received in 1871 than during the previous year. Total passengers carried last year, 366,818. Mr. Frazer, the President of the company, concludes his very succinct and satisfactory report with the declaration that "the receipts for the year, after deducting the running expenses, interest, insurance, taxes, etc., were still sufficient to have paid a dividend of about nine per cent. on the entire stock. The balance, however, was appropriated to renewals, construction and additions to the rolling stock—expenditures not likely to be required during the present year—and as there appears no reason to suppose the business will diminish, but, on the contrary, as the prospect is that it will increase, the stockholders have grounds for a reasonable expectation of receiving a dividend out of the year's operations." The capital of the company is $1,190,700, and the funded debt, in first and second-mortgage bonds, $990,000.

Contributions.

Train Dispatching—A Criticism of Hindoo's Code.

To the Editor of the Railroad Gazette:

The discussion of train dispatching in the Gazette is beginning to assume a definite shape. Superfluities are dropping out. The mist of unsupported assertion and denial is clearing away, and outlines of practical facts are becoming distinct.

A brief review of the main points that have risen from time to time above the level of what has thus far been written upon the subject will show what advance has been gained, and thus simplify the future progress of the investigation.

"Hindoo" opened the ball with the assertion that there was no system of train dispatching in this country, and proposed the introduction of the Indian system. This bold and unexpected invasion of territory hitherto untouched brought out such various and vigorous protestations, responses and fragmentary allusions to the "way we do it here" that "Hindoo" was fain to change his plan of attack, and bring forward his next conclusion, namely, that there were entirely too many systems, jumbled together in chaotic confusion, undefined, destitute of written law, and consequently unsafe and altogether worthless.

Then came the clear and well written statement of "X," in which the principles of the American system were distinctly presented, and a fatal objection to the Indian system discovered, in its want of provision for blockades. "Hindoo" candidly admitted the defect, but thought that the Indian and American systems might be combined in such a manner as to get rid of the faults and retain the advantages of both. In advocating this combination "Hindoo" attempted to criticise some of the features of the American system. Here became manifest the error which had misled him from the first. He had mistaken details and technicalities for principles. He had dealt with detached fragments of rules as if they were complete and independent. He forgot that each part of a system is vitally allied to every other part, and that the whole can only be comprehended through a knowlege of the relations of all the parts to each other. The result was that he misunderstood and misstated the rules upon which he undertook to pass judgment.

This brought another Richmond into the field in the person of "B," whose plain and direct method has cut a broader path into the problem and has cleared away much of the rubbish with which it was encumbered. He explains, by practical illustration, the meaning and force of rules which "Hindoo" had misconstrued, points out the safety checks that rightfully belong to them, admits that accidents have occurred through violation of the rules; but shows by his exhibit of traffic that such violations are exceedingly rare, and fairly claims that such results unmistakably indicate a living system.

In the meantime "Hindoo" publishes a code of rules, in which he has worked out his idea of a combination between the Indian and American systems.

The case seems to stand now about as follows: The Indian system is utterly impracticable in this country, and, therefore, demands no further attention.

The American system is comprehensive enough for the heaviest traffic, and its working is so simple as to be readily adjusted to the wants of any line under all changes of circumstances. It has grown up with the traffic to which it is attached, and its principles have been founded by induction upon the varied conditions which this traffic has developed. It has now become a structure too large and too symmetrical to be incontinently upset by light puffs of wind, however suddenly they may strike it. Its only objectionable feature is that it must be carefully handled. Although it is protected by strong and clearly defined safety checks, it still imposes great responsibility upon its manipulators. Now, then, whoever undertakes to improve upon this system or put another in its place, must demonstrate, practically, that he can reduce its risk without impairing its capacity. No excellences can redeem and no other defect need be pointed out in any code that will not bear this test.

Under the new code proposed by "Hindoo," it would take about 16,000 words of telegraphing to transmit between station-masters the bare messages necessary to get 25 trains over 125 miles of line with 20 stations in 12 hours, provided no messages were cancelled. Add to this the messages between the dispatcher and station-masters, explanations of delays, messages to conductors in regard to the distribution of cars, directions for picking up and setting out loads, etc. Then take into consideration the inevitable changes and unexpected incidents that are bound to occur, and the messages they necessitate, and add 2,500 words as a minimum for reports of arrivals and departures of trains, and there will appear a total of not less than 25,000 words, say 2,000 words an hour. This estimate does not provide for extraordinary accidents, which would demand a great additional amount of telegraphing.

All who are familiar with the subject will see at once that such a performance is impossible.

If this statement be approximately correct, there is no occasion to examine further the merits and defects of "Hindoo's"

code. Like the Indian system, it lacks the essential element of adaptability to the requirements of American railway traffic.

Genuine and practical improvements in train dispatching may be found in a comparison and criticism of the different forms in which the system is operated upon different lines rather than in a search after new systems.

How to express the principles of this system in language that cannot be misunderstood or misconstrued, and in rules that will apply to all possible contingencies of the traffic, is the question that deserves the best attention of those who are interested in the elevation and advancement of this branch of railway service.

S.

The Qualifications of Train Dispatchers.

TO THE EDITOR OF THE RAILROAD GAZETTE:

There is something radically wrong in the system of train dispatching upon some, if not upon all, of our railroads. It is considered by men well versed in the management of railroads that it requires years of experience to qualify a man to occupy the position of superintendent, conductor or engineer of a railroad; but some of our railroad managers have fallen into the error of supposing that it need take but a few months to educate a boy, whose only qualification is the skill to send a telegraph message correctly, to perform the most responsible of all duties upon a railroad, viz., that of dispatching trains.

It has been considered by the Congress of the United States necessary to pass a law licensing pilots and engineers of steamboats and ships navigating the ocean and the streams of the country, and putting the most severe penalties upon the owners of vessels for employing incompetent or unlicensed men, and I cannot see that the responsibility is any less upon railroads, where there is a single thread upon which to navigate, than upon broad oceans and rivers, where there are innumerable tracks. Railroad managers of experience select good men for their different departments and hold them responsible for the selection of their subordinates; but some have fallen into the error of not only ignoring that essential point, but those of *experience* have, I think, gradually, almost imperceptibly, changed the whole character of the management of their roads and put them into the hands of young and inexperienced men, not brought up to the business of railroad management, until the time table has become almost a useless thing, and the ability formerly necessary in a conductor to manage his train and run according to time has been rendered useless.

Men grown gray in the performance of their duty as conductors and engineers, who have made railroad business their study, receive their orders from mere boys frequently who know neither the grade of the road, the capacity of the engines, nor the length of the side-tracks, and, indeed, have no other quality than that of being expert at the telegraph-key and the knowledge of the phraseology of telegraph orders.

An old conductor may sometimes approach a dispatching office to ask for orders, and some youngster whose ears he has lately pulled as a peanut-boy, now train-dispatcher, gives him his order to run. Should he have the hardihood to criticise the order, he suffers the penalty by being told to dry up, and is laughed at besides.

In addition to this radical error in the system there is another. The telegraph dispatching offices are entirely too public, to say nothing of the other telegraph offices, which are likewise too much so. You will see a noisy crowd gathered about, and frequently in, the dispatching offices, while the numerous instruments are making an infamous din, quite enough of themselves, and Tom, Dick or Harry, of the ——— line, will go right up to the dispatcher and howl in his ear, "I say, Bill, is the night express on time?" while messages for which they are responsible, concerning the very lives of many passengers, are flashing over the wires.

These dispatching offices should be kept closely guarded; no one should enter, and men should be in them who command respect and who know fully their responsibilities and are alive to them. How often can we now trace some of the most terrible accidents that have shocked our country to the youth and heedlessness of those intrusted with the dispatching and receiving of train orders.

There is too much reliance placed upon the system. It is good as an adjunct, but too heavy to carry as the main system by which to run our roads, unless more experienced men are selected. But few are capable of holding the position, and those after not only long practice at the key but experience upon the road.

It would be well to encourage every man on the line to learn the art of telegraphy, and then select from among the ablest for train dispatchers. Until some lessons are learned in the matter many millions of money and many thousands of lives will be sacrificed as a hecatomb to railroad management.

OBSERVER.

The Proposed Channel Ferry.

Most European travelers involuntarily assume a nauseated expression when they speak of crossing the English Channel, and those of us who have been so fortunate as to be able to stay at home and have not felt constrained to wander to and fro on the other side of the Atlantic, as is the habit of many American travelers, are familiar from descriptions and illustrations with the discomforts of that brief voyage. In order to lessen these it is proposed by Mr. Fowler and several other English engineers associated with him to provide large and powerful steamers, with suitable well-sheltered harbors on both coasts, capable of affording ingress and egress at all states of the tide and weather. The above engraving, which represents a section of one of these proposed steamers, and the following description we have copied from the *Graphic*:

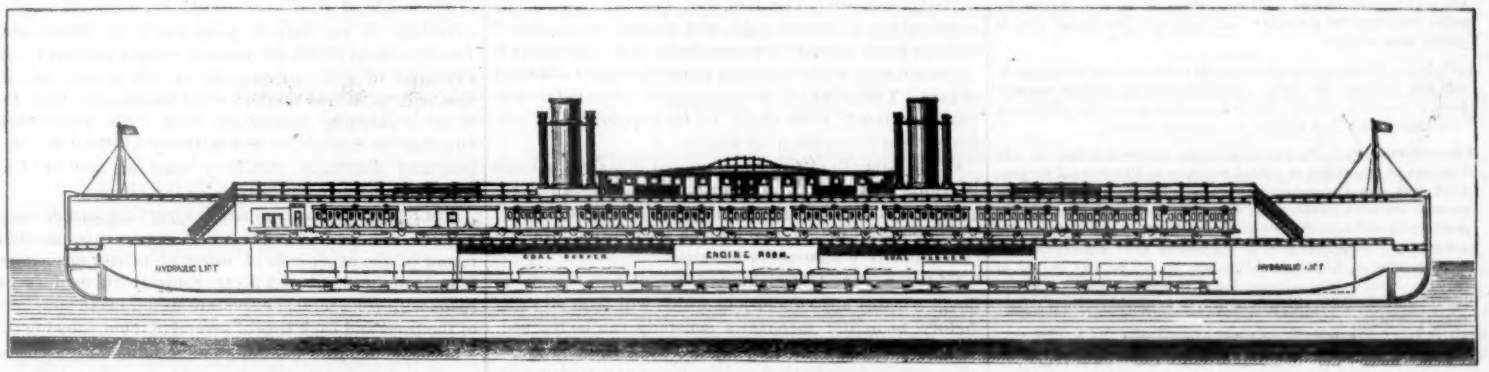
The steamers are proposed to be 450 feet in length, 57 feet beam, and 95 feet over the paddle-boxes, propelled by disconnected engines of 1,400 horse-power nominal, by which such a rate of speed will be attained as will enable them to perform the voyage from shore to shore in one hour, while from their form and size motion in any state of the weather would be almost imperceptible.

As regards providing rapid means for the interchange of passengers and goods traffic between the railways and the ferry stations, and under perfect shelter, it is proposed to form covered water stations into which the train will run, and under which the boats will be to receive the trains, so that all interchange, both as regards through carriages and otherwise, will be effected in still water and under the shelter of a roof affording complete protection from wind or rain, the transfer of the trains into the steamers being effected by hydraulic machinery designed in such a manner that each transfer can be effected within a period of five minutes, and the passengers will not be required to leave the trains until they are run on board the vessels, when they can alight from them on to platforms similar to those of any ordinary railway station.*

The steamers will be luxuriously fitted up with first and second class refreshment saloons, ladies' and private cabins, together with a custom house for the examination of luggage, so that the passengers will not only have the advantage of securing their seats in the railway carriages throughout the entire journey without change, and thus avoid the present great discomfort of change and separation of families and friends, but they will also have all the accommodation afforded on the deck and in the various saloons and cabins—in short, the passage across may be regarded simply as a rest of an hour at a first-class railway station.

By these combined arrangements the voyage across will be effected in one hour, and a saving of at least two hours in time as between London and Paris, as time will also be saved in the interchange of passengers and goods—but the saving of distance and time, although important, are insignificant compared with the certainty and comfort secured to passengers under all circumstances of wind and weather, and the great additional facilities which would be afforded for the continuous transit of the great and constantly increasing goods traffic.

* The goods trains are accommodated in the hold of the vessel, the lighter passenger trains on the middle deck, both trains together being very insignificant in weight as compared with the carrying capacity of the vessel.



PROPOSED CHANNEL FERRY STEAMER.

THE SCRAP HEAP.

Pressure in Steam Boilers.

The *Journal of the Franklin Institute* says: "The question as to whether the pressure in a steam boiler was equal or different at top and bottom, concerning which there seems to be some difference of opinion among engineers—though it is difficult, from the simplicity of the facts involved in considering the question, to see how a difference of opinion should exist—has nevertheless been experimentally determined by the Messrs. Hunter, at their establishment in this city [Philadelphia]. An elbow was attached to the end of the blow-off pipe which entered the mud-drum; into this a plug was screwed, and tapped to receive a half-inch pipe; to this a steam-gauge was attached and the cock opened. On comparing the indications of the gauges attached at top of boiler and to the top of drum, as above described, it was found that the pressure was greatest at the bottom by a pound and a half, proving, as might readily have been predicted, that the pressure upon the bottom of a boiler is equal to the steam pressure indicated above, plus the weight of a water column equal in height to the difference in level between drum and surface of water in boiler, and in diameter to that acting on the gauge."

A similar question has been raised in regard to the steam pressure at the end of a steam pipe extending some distance from the boiler. This we saw tested some years ago in the repair shop of the Baltimore & Ohio Railroad. The stationary engine boiler was located on the first floor at the end of a shop almost 200 feet long. The office was at the other end of the building on the second floor. Mr. Thatcher Perkins, who was then Master of Machinery on that road, had a ¼ in. gas pipe attached to the boiler and extending to the office at the other end of the building to a steam gauge in his office. There was also an escape cock at the same end by which the steam and condensed water in the pipe could be blown out. The pressure in the gauge when the cock was closed was exactly that in the boiler less that due to a column of water equal to the difference in height between the gauge and boiler. As soon as the cock was opened, however, the pressure indicated by the gauge would fall very far below what it indicated when it was open, showing that a large part of the power or pressure of the steam was absorbed by the friction and condensation resulting from its passage for so great a distance through so small a pipe.

A Train Stopped by Sand.

It is reported that recently a train was thrown from the track on the San Joaquin Valley Railroad in California by a drift of sand which the wind had blown upon the track. It is said that in some places the sand was a foot deep over the rails.

Pittsburgh Locomotive Works.

These works are to be enlarged to a capacity for six or more engines per month.

American Bridges in Central America.

The Phœnixville Bridge Works have recently completed and shipped, within twenty-one days after receiving the order, two iron bridges for the new railroad in Costa Rica. One of these was a through bridge of 65 feet span, the other a deck bridge of 130 feet span. The number of pieces (which affects the time necessary for the construction more than the weight) in these two bridges was 1,300, and if the spans had been 200 feet the order could have been executed quite as speedily.

The Cincinnati & Newport Bridge.

The following description of this bridge, just opened for regular railroad traffic, we take from the *United States Railroad and Mining Register*:

"The northern approach, commencing near the Little Miami Railroad depot, is carried on embankment and trestles to Eggleston avenue, at which point the superstructure begins, thence by curves of 560 and 609 feet radii, and grade of 2 feet per 100 over one undergrade

span over Eggleston avenue	90	feet.
6 undergrade spans to Front st., 78½ feet each.	450	"
1 overgrade span over Front street	120	"
Brick arcade	141	"
2 undergrade spans, 96 feet each	192	"
Thence on tangent in line of Butler street, Cincinnati and Saratoga street, Newport, at same grade on 1 overgrade span	137½	"
Then on level 1 overgrade span	420	"
Thence descending 2ft. per 100 on 1 overgrade span	237	"
1 overgrade span	260	"
2 overgrade spans, 202 5 feet each	405	"
1 undergrade span, Front street, Newport	132½	"
Brick arcade	180	"
1 undergrade span, Market street	50	"
Brick arcade	130	"
Retaining wall	145	"
Total iron superstructure, including 97 feet of plate girders for roadway at Front street, Cincinnati	2,691	"
Brick arcade	451	"
Retaining wall	145	"
Total	3,287	feet.

"The two roadways commence in Butler street, Cincinnati, and passing under the railway span on curve at Front street, soon attain the elevation of the railway track, and passing the channel span, one roadway on each side being carried on cantilevers projecting outside of the main trusses. Descending with steeper gradient the roadways terminate near Market street, Newport.

"The bridge was commenced in 1869, George B. Roberts, Esq., having general direction of the project for the bridge company, John C. Wilson being appointed Resident Engineer, and J. H. Linville, Chief Engineer of superstructure, and the designs for same were prepared and executed under his directions, the work being done by the Keystone Bridge Company, who have erected the other large iron bridges over the Ohio at Steubenville, Belair and Parkersburg from similar designs.

"The channel span is the feature of especial interest, from the fact that it is the longest span of iron truss bridge yet executed on this continent. The truss is 40 feet in height, 420 feet in length, and proportioned to carry a live load of 2½ tons per lineal foot, with the usual factor of safety."

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Editorial Announcements.

Address.—*The* RAILROAD GAZETTE *will be printed for the present in New York; our printing house in Chicago having been destroyed. All communications, therefore, whether editorial or business, should be directed to the New York office. The proprietor will receive subscriptions and advertisements at his office in Chicago, Nos.* 63 *and* 65 *South Canal street, but letters should be addressed to New York.*

Correspondence.—*We cordially invite the co-operation of the railroad public in affording us the material for a thorough and worthy railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.*

Articles.—*We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay.* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

THE MASTER MECHANICS' CONVENTION.

On another page will be found an announcement of the change in the time for holding the annual meeting of this Association. When a change was first discussed, the 18th of June was the date selected for holding the convention; but owing to some difficulty in procuring hotel accommodations at that time, it was necessary to select another week, and the committee therefore fixed upon the 11th. In some respects the necessity for making this second change was unfortunate, as the Master Car-Builders' Association will hold its annual meeting during the same week in St. Louis. In some cases the same person fills the position of both master-mechanic and master car-builder, and therefore will be able to attend only one of these meetings. In other cases it is difficult for both the master-mechanic and the person who has charge of the car department on the same road to leave at the same time, and therefore one or the other will be obliged to stay at home. The fact, however, that the Master Mechanics' Convention will be held in Boston on the 11th of June is officially established, and all its members who are interested in its proceedings should strive to make the coming meeting not only of equal but of greater interest than those which have preceded it.

Committees have been appointed to report on the following subjects: Boilers and boiler material; the relative merits of straight and "wagon-top" locomotive boilers; boiler incrustation; safety valves; lap and lead of slide valves and to discuss the throw of eccentrics and the general principles of valve motion; steel tires; the best method of securing driving and truck brasses; the best method of constructing tender trucks; is there any material or device for packing stuffing boxes more economical than hemp? application of compression brakes; relative merits of narrow and broad-gauge railroads; comparative performance and cost of operation of ten-wheeled engines with six drivers coupled, and eight-wheeled engines with six drivers coupled; uniform system of computing mileage of engines doing switching service; uniform system of examining locomotive firemen for promotion; advisability of establishing different grades of locomotive engineers, according to length of service, character, etc.

A glance over this list will show that the scientific bill of fare which has been prepared for this next meeting is fully equal to that of any of those which have preceded it. Whether the intellectual food to be served up will be prepared with equal or greater care and skill, will only be determined when the convention meets. It is, however, very certain that the success of this, as of all feasts, will be determined, not by the character of the bill of fare, but by the quality of the meat and drink which is supplied to the guests. The success of the meeting and the estimation in which it will be held by those who participate in or are interested in its proceedings will depend in a very great measure upon the care and ability with which the members of the committees fulfill their duties.

It may possibly be thought—and we confess to somewhat of the feeling ourselves on first hearing the list of subjects announced—that very little could be said of any or most of them. A more careful consideration we think, however, will lead to a different conclusion. In fact, careful investigation is needed in regard to each of the subjects proposed for discussion, and there is hardly one of them on which a person of experience and ability might not write a reasonably large and useful book.

Of boilers and boiler material, accurate knowledge is sadly needed. The fact is we are so ignorant of much that relates to boilers and the material of which they are made, that unless a committee should give its entire time to original experiments and investigation for several years, there is little danger that it will furnish replies to all the questions which are now awaiting answers. There are, however, practical questions which need immediate reply and which should receive their attention. Among these is the staying for crown sheets and other portions of boilers which is requisite to insure safety. That very gross ignorance and carelessness exist in regard to this part of the construction of locomotive engines, the frequent and lamentable explosions which have recently occurred strongly indicate. The fact, too, that this part of the construction is out of sight and cannot be examined without much personal inconvenience and discomfort is another reason which points to probable neglect and want of care. Things which are constantly subjected to criticism are much more likely to be improved and perfected than those which are hidden.

Of the strength of riveted seams and of plates the holes in which are punched, as compared with those which are drilled, and the relative merits of machine and hand riveting are all points about which the existing information is not very accurate or definite.

Of the merits of straight and wagon-top boilers we doubt whether any conclusions which will be at all satisfactory to master mechanics generally can be reached. The advantages claimed for the one over the other are so often merely hypothetical and the result of casual impression that we find locomotive builders generally have quietly surrendered this point to the prejudices or opinions of those who give them orders. To arrive at conclusions which will have any practical value, the comparisons must be based upon the weight of the boilers. In nearly if not quite all cases, the weight of locomotive boilers is limited. If, therefore, the weight of a boiler can be 20,000 lbs., the question for the committee will be: What will be most efficient, 20,000 lbs. of wagon-top or 20,000 lbs. of straight-top boiler. The first form requires stronger bracing and staying, and, therefore, the other may be made of somewhat larger dimensions and yet not exceed the first in weight. The weight is also an element to be borne in mind when the efficiency of different devices for burning coal are compared. The question regarding their efficiency and economy will nearly always resolve itself into one of weight.

Of incrustations, we in common with some hundreds or thousands of other people want information. We confess we know very little about the subject, and certainly are not aware of any sovereign remedy for the evil. We are quite sure, however, that a great deal of matter gets into boilers which should not, and does great injury there; and the man who can tell the master mechanics at the convention how to exclude the foreign substances may be sure of having very attentive listeners.

The committee on safety valves is especially requested to give its attention to the practicability of diminishing, in some way, the infernal (no other word is strong enough) noise made by some valves now in use when the steam is released. The noise which they now make frightens horses and almost sets a nervous person wild or a timid one frantic. A plan suggested by Mr. Tilghman, of Philadelphia, we have been told, has worked successfully, and is very cheap and simple.

The committee which has a report to prepare on the "principles of valve gear" has rather a formidable task, if it makes its report at all exhaustive. If it succeeds in bringing about anything like uniformity of opinion in this department of locomotive practice, it will accomplish what we do not believe is possible by any human authority. The reason for thinking so is, that if there is any one subject on which all men having anything to do with locomotives think themselves competent to give an opinion, it is on that of the proportion of valve gear, and their dogmatism is nearly always in direct proportion to their ignorance of the subject.

With reference to steel tires there is not much to be done, except to compile statistics and do it carefully and honestly.

On the best method of securing driving and truck brasses and constructing tender-trucks, the committees will have no exact data from which to draw their deductions, but will be called upon to exercise their judgment in the recommendations they may make.

Of the subject which comes next in order in the annual report, probably most persons will feel disposed to ask of the reporters, "if there is any material for packing stuffing-boxes better than hemp," what is it?

If the report on the application and use of compression brakes will simply give the testimony of those who have used them for the past year, with statements of the expense of keeping them in repair, of their efficiency when a train breaks apart, and of any failures to operate at critical times, it will be doing perhaps what is now most needed, or at least the most that is practically possible for it to do. That some of the compression-brakes now in use are working very efficiently there can be no doubt; and of their success much has been said of late. What is now needed is to learn of their imperfections, of which there doubtless are some to report.

Of the relative merits of broad and narrow-gauge railroads there will probably be a very earnest discussion and great diversity of opinion. As nearly all the reasoning in favor of the narrow gauge is based upon the difference in the weight of cars for such roads and those of the same capacity and strength for a wide gauge, if the discussion should be directed to the consideration of this question, and it could be determined what the difference in the weight of such cars would be, then the relative advantage of the narrow gauge could be determined. The statements of the difference in weight claimed by the advocates of the narrow gauge is now merely assumption, and is oftener due to a vivid imagination than the result of carefully ascertained facts. We hope, therefore, that the convention will maturely consider the subject, and determine definitely what amount of dead weight can be saved by narrowing the gauge.

The reports on the comparative performance of locomotives of different designs will of necessity be merely a record of the experience of different master mechanics. If some of the members who are using Mogul engines on roads with considerable curvature would make templates of the front and back tires of several of them, showing the wear of the flanges, and do the same thing with a similar number of ordinary eight-wheeled locomotives, and give the mileage of each, they would make a very valuable contribution of knowledge regarding this subject.

On a system of examination for promotion and classification of locomotive runners and firemen the committee can do much good every way. That the practice of paying good, bad and indifferent men alike is very unjust and takes away one of the strongest motives for the faithful performance of duty, there can be little doubt; but to devise a more just system which will work well practically, is no easy task, and will tax the skill, experience and knowledge of the members of the committees.

From the time this meets the eyes of most of our readers to the date of the meeting of the convention there will be about six weeks available for preparing reports and other work of the Association. All who have not yet replied to the circulars and inquiries of the committees we would urge to do so at the earliest moment. A few hours devoted to this duty in the evening, if there is no other time, will be sufficient, and the great value of the proceedings of the Master Mechanics' Association lies in the reports received from the members engaged in practical railroad operations. Many of them, we know, do not realize the value of the information which they have at their fingers' ends, and which only need be collected to be made available the world over. In our intercourse with American master mechanics we are often struck with the confidence with which they will make assertions concerning the most abstruse theories, and the very great uncertainty which exists in their minds concerning the plainest matters of fact which come under their notice every day. They will feel able to tell exactly what result will follow if a thirty-second of an inch more lap or lead be given to a locomotive slide-valve, but very few of them can tell accurately what proportion of broken car-axles are fractured inside of the hub of the wheels. As a general principle, the theories of master mechanics are not worth nearly so much as their facts, and therefore all who are interested in the Association's proceedings will contribute of the latter, which they can do with very little trouble; whereas the former will require much time to elaborate, and in all probability will not be worth nearly as much as those things which appear too obvious to them to take any note of.

There are several dangers to which the Association is exposed: chiefest of these is partiality in making reports. Should any of them favor unjustly, from any motive whatsoever, the interest of any inventors, manufacturers or dealers in railroad material, it will be sure to cause general distrust in all the proceedings, and create active and unrelenting enemies of the Association. Members should therefore guard the integrity of the Association in this direction more jealously than anything else, and visit with prompt and instant expulsion any member detected in any chicanery of this kind.

Another danger is the indifference of the members, and the absence of some master-mechanics who have thus far not become members of the Association. There is a number of such who have held aloof, and who would make very desirable members if they could be induced to attend the meetings. Those who are now active members, and who can influence such as are not, should exert themselves to induce the latter to attend the next meeting. That the convivial character of some of the sessions did somewhat to injure the repute of the Association, there can be no doubt. This, we think, was to a very great extent unjust; but the fact remains, nevertheless, and a very strong feeling prevails among the members against participation in such hospitalities. We have before us the following slip cut from a New England paper:

"It must be remembered that the Railway Master Mechanics' Association of America are to hold their next annual convention at Boston. * * * It is essential that New England manufacturers do their duty, and receive them in a manner that shall not only be acceptable but creditable to the section they propose to visit. We trust the manufacturers of every description of railroad supplies will take hold together and give them a bumper."

The correspondent who inclosed the above to us is an active member and writes: "I, for one, hope there will be nothing of the kind. I believe that a large number of the master mechanics think of these matters the same as I—that they are an injury to the Association; that they cause an impression to get abroad that the meetings are got up only for the purpose of having a good time. There was nothing of the kind at Louisville, and you will find it the general opinion of all who were there that more business was transacted and all felt better satisfied than at any previous meeting." We fully indorse what he says.

Narrow Gauge in the United States.

Engineering, in an editorial on "Narrow Gauge Progress," says: "It is less than a year since the advantages of narrow gauge became firmly fixed in the Western American mind; yet to-day nearly all the new lines being constructed or projected in the West are narrow gauge."

It is, of course, not to be expected that an English journal should have complete and minute information concerning American railroads: still this extraordinary statement is quite unaccountable.

We make it our business to obtain (and give) information concerning the progress of all new lines whatsoever, and we are very sure that not one-twentieth—and probably not one-fiftieth—of the lines in progress are narrow-gauge roads. We are likely to lay track on six or seven and perhaps eight thousand miles of new railroad during the year 1872, three-fourths of it in the West. Of this probably not more than from two to three hundred miles will be narrow gauge.

That there are projected narrow-gauge railroads to the amount of several thousand miles is not improbable; but then there are probably a million or two miles of standard-gauge railroads projected, there being not many townships in the United States which have not a "projected" railroad. We are accustomed, however, to count the railroad only when the rails are laid; the organization of a company signifying little; the letting of a contract, not much; the completion of considerable grading, even, only a probability (as hundreds of miles of old road-beds testify). The slips between the cup and the lip are increased in the case of a narrow-gauge railroad by the possibility that after all it may be made of the standard gauge—a fate that has befallen several promising narrow-gauge projects.

Some of the lines mentioned by *Engineering* are the merest shadows, for which not even charters (which may be had for the asking) have been obtained. Such are the "great through line direct between St. Louis and New York," which was never seriously contemplated, and that "joining the Pennsylvania coal districts to New England." The Cincinnati & Terre Haute Railroad, which is mentioned as under way, is not, we believe, yet begun, but *is* to be of standard gauge. The Texas Pacific is more likely to be made of standard than of narrow gauge, we are told, and the Pennsylvania is not building branch roads of narrow gauge. The longest narrow-gauge road completed in the United States is the Denver & Rio Grande, now 76 miles long, and soon to be extended a considerable distance, though we imagine that it will be some time before it will reach the city of Mexico. Another considerable line pretty well under way is the Cairo & St. Louis, about 130 miles long, and the Leavenworth & Denver, we believe, hopes to have forty miles completed this season. There is a little work done on a narrow-gauge railroad in Iowa, a very short line is in operation in Alabama, other short lines completed in Utah and elsewhere, and more or less grading has been done on a number of lines in different parts of the country, mostly quite short; but, as we have said before, the accomplishment of a certain amount of work by no means insures the completion of a railroad, whether of narrow or wide gauge.

As for the history of the narrow-gauge movement in this country, not nearly so many lines of that gauge are being projected now as were a year ago. Then most of the narrow-gauge companies were organized by men with no knowledge either of engineering or railroad operation. When these companies have come into the control of experienced railroad men, as they have occasionally, their first step frequently has been to adopt the standard gauge.

Railroad Companies and their Employees.

Mr. Charles Wilson, who is widely known among railroad men as the chief executive officer of the Brotherhood of Locomotive Engineers, in a recent letter in which he calls attention to some remarks made by a contributor concerning provisions by railroad companies for the welfare of their employees, says: "I regard the contribution from 'Hindoo' as both opportune and eminently sensible. The argument he makes to show that the interests of the railway manager and his employees are identical is founded on a rock, and the effort he makes to insure harmony and good treatment between employer and employee should entitle him to the thanks of all concerned. * * * I heartily second his motion to make some definite arrangements to provide for all classes of distress among all worthy railroad employees; and I hazard nothing in asserting that there is not an employee in the service of any railroad company in this country but would gladly improve the opportunity of devoting a small share of his monthly earnings to help provide a fund to secure a benefit to himself or family, in case of injury, sickness or death. The railroad companies need not provide all the means; a large share would be given by their employees simply by the asking.

"If railway managers could be induced to consider the difference between the position occupied by their employees and those of men engaged in other pursuits, and fully realize the vast responsibilities they impose upon them, and then be able to make comparisons between a liberal system of treatment and an arbitrary one, our troubles would be at an end. Kindness and a friendly interest for the employee cost nothing, while they secure that which cannot be purchased with money—faithfulness."

Wanted, a Name.

In writing about locomotives we have often been embarrassed for the want of some concise name to designate different kinds of engines, and especially the ordinary plan of American locomotives with four driving-wheels and four-wheeled trucks. The term eight-wheeled locomotive may mean a locomotive with eight driving-wheels connected, or it may mean one of the "Mogul" class, with three pairs of wheels connected and Bissell truck, or a "Forney" or "Fairlie" tank engine. To specify accurately what is meant when we speak of such engines we must say *an eight-wheeled engine, with four driving-wheels and a four-wheeled truck*. This involves the use of thirteen words, and is therefore very cumbrous and inconvenient. As engines of this description were first introduced and are now most generally used in this country, and have not been much adopted in Europe, we suggest the term "American" locomotives for this class of engine. If the leading builders would adopt this title, and simply use it on the photographs and other illustrations of their engines, its use would soon become general and be universally adopted, much to the convenience of those who write and talk about them.

The Kansas Pacific Railway, ever since its completion, has been in the field as a competitor with the Union Pacific for the traffic to the Pacific. It has the advantage of being for St. Louis and the country as far south as that place, about as short a route, and the farther and considerable advantage of taking Denver and Colorado on its route, and forming the best means of access to the attractive scenery of that territory, which most of those going to the Pacific for pleasure would be glad to see. But it had, and has, the great disadvantage of being dependent upon its sole rival for a part of its route. The Kansas Pacific can carry passengers as far west as Cheyenne, and doubtless can be sure of good terms enough from the Central Pacific, but from Cheyenne to Ogden the Union Pacific owns the road, and, not looking with favor on any schemes to take away a part of its traffic, it has, to say the least, not encouraged through traffic by way of the Kansas Pacific. The latter company has to pay local rates for all the passengers for points on the Central Pacific which it delivers at Cheyenne, which leaves it, if we remember rightly, *ten dollars* for the distance from Kansas City to Cheyenne—740 miles—which of course don't pay. Now the Kansas Pacific claims that the Union Pacific is legally bound to carry its passengers as cheaply as it does its own through passengers, and it has caused to be introduced into Congress a bill ostensibly providing for the enforcement of these obligations.

If there are any such provisions in the charter of the Union Pacific as will compel it to be a party to a combination to divert traffic from its own line, it is unfortunate for the Union Pacific, and puts that road in a situation unlike that of any other American railroad. It is not as if travel was compelled to make a long circuit in order to get the advantage of its through rates; for the distance is a little shorter even from Kansas City by way of the Union than by way of the Kansas Pacific. Every passenger who goes by the latter uses but one-half instead of the whole of the Union Pacific. Moreover, there are other companies which will be ready to divert traffic from the eastern part of the northern line. The Burlington & Missouri River Railroad of Nebraska very soon will have trains running through to a junction with the Union Pacific at Kearney, 191 miles west of Omaha, and the St. Joseph & Denver will be completed to the same point within a few months. Should these, with the Kansas Pacific, be able to compete on equal terms for traffic which must pass over one-half or three-fourths of the line of the Union Pacific, they might, likely enough, divert a third or a half of the gross traffic and receipts of the eastern part of the latter. It is much as if the Baltimore & Ohio should compete with the Pennsylvania between Baltimore and Chicago, by using on equal terms the latter's leased line from Pittsburgh to Chicago.

If, however, the privileges here claimed were among the conditions accepted by the Union Pacific with its charter and subsidy, there is nothing more to say. If the company didn't like the conditions, it shouldn't have accepted the charter.

Leavenworth celebrated the completion of its new bridge over the Missouri with great enthusiasm on the 18th of this month, there being speeches, music, processions, and a crowd in attendance estimated at 20,000 persons. The event was certainly one worth celebrating by Leavenworth, which is, for a Western city, old and very wealthy, but has not made such rapid progress as it promised to ten years ago—at least has not maintained its comparative position among the Missouri River towns, a concentration of railroads at Kansas City and the earlier completion of the bridge at that place having almost created it within that period and caused it to grow with extraordinary rapidity. Leavenworth has now two routes to St. Louis and two to Chicago, both of the former being also routes to Kansas City; but only one of the latter; the Chicago & Southwestern has connection with no other Missouri River city than Leavenworth at present, though it will soon have a branch to Atchison, and it will be to its interest to cultivate Leavenworth business as against Kansas City—at least until it has a line to the latter place. The prosperity of the town hereafter will depend more upon the completeness of its connections with the country west of the Missouri, and in this it is now behind Kansas City: but it has numerous roads projected and some in progress, and is trying to induce others already in operation to make their main outlet at Leavenworth. For instance, it hopes to have trains of the Leavenworth, Lawrence & Galveston—whose terminus now is practically at Kansas City—and of the Atchison, Topeka & Santa Fe—which will reach the Missouri at Atchison—run into its depots, and also to divert a large if not the largest share of the Kansas Pacific traffic from Kansas City to the Leavenworth Branch. To effect all this certainly will be no easy task; but the Missouri River towns are all young still, and the skillful use of capital and certain possible combinations of railroad companies may make wonderful changes within the next twenty-five years.

The new bridge is supported on iron cylinder piers, very like the Omaha structure, and has cost only about $800,000. We described it in detail, with illustrations, last summer.

"Colossal" is the term used to describe a scheme which Wall street has been talking of this week, and which is described as a combination of the Erie, the Canada Southern, the Toledo, Wabash & Western, the Hannibal & St. Joseph, the St. Joseph & Denver, the Kansas Pacific and the Central Pacific, who are to construct a line from Denver to Salt Lake to unite the Kansas with the Central Pacific, and thus provide a grand route from New York to San Francisco, which is to command all the traffic between those places, the same embracing—in the eyes of some people—pretty much all the traffic there is. It is reported that this will give a route 60 miles shorter than any now existing.

The men who started the story concerning this "colossal" scheme were somewhat careless as to probabilities and somewhat neglectful as to facts. Why the St. Joseph & Denver should be included, for instance, does not clearly appear: probably the minds originating the scheme supposed that it in some way connects the Hannibal & St. Joseph with the Kansas Pacific, whereas it cannot be used in connection with the latter, and will make a section of a route to the Pacific only in connection with the Union Pacific or a parallel line. Moreover, giving a very short and favorable line for the uncompleted section from Denver to Salt Lake, the proposed route would be more than 3,400 miles long—not sixty miles shorter but ninety miles longer than the shortest route by way of Chicago and Omaha.

However, it is a waste of time to discuss such a scheme. Its purpose, if it had any, was probably to depress Union Pacific stock by creating the impression that a great combination would soon deprive it of the Pacific traffic.

The Board of Health of New York have recommended that two ventilating cowls should be placed on each street car, with holes beneath the seats. The report of their resolution before us does not state whether the holes beneath the seats are intended for exhausting or supplying the air. If the former, those who have studied this subject will be inclined to ask where the supply is to be introduced. If, on the other hand, the air is admitted by these holes, it will cause great discomfort to the passengers in cold weather, by coming in direct contact with their feet. With the present appliances there is not much difficulty in ventilating a car reasonably well if conductors and passengers can be induced to keep the ventilators open or give them the requisite attention. To a person who rides in horse or any other cars often, it is hardly necessary to say that they will not do this; and therefore, in making provision for ventilation, this indifference or ignorance is one of the elements to be taken into consideration. The difficulty is to supply or admit enough fresh air, especially in cold weather, to keep that in the car pure. There is not much trouble in exhausting it, and the cowls and holes under the seats might answer very well for that purpose, but some provision must be made for admitting the air, and it must be so arranged that passengers will not know that it is admitted, and that neither they nor the conductor can close the apertures through which it enters.

This, we believe, could best be done by substituting fixed Venetian blinds for the glass door in the ventilators over the doors.

By inclining the slats upward from the outside, the current of air will be directed against the roof of the car, and thus will not be felt by the passengers. At the same time few will see that the ventilators are open, as little light will be admitted and rain and snow will also be excluded. A current of air will enter at the front end and escape at the rear, and thus constantly change that in the car. In mild weather the other ventilators, windows and doors can, of course, be opened. The experiment could at any rate be easily tried at an expense of a few dollars. Who will try it and report to us its success?

THE IRON PRODUCTION of the United States is reported for the year 1871 by the American Iron and Steel Association. The figures are in many cases estimated, but are supposed to be very near the truth.

The pig iron produced is reported at 1,912,608 tons, against 1,865,000 tons in 1870 and 1,916,000 in 1869. The total capacity of the blast furnaces existing at the close of the year was 2,500,000 tons per year. Of the production of 1871, 957,608 tons, or the merest trifle more than one half, was anthracite pig; 570,000 tons was produced by coke or raw bituminous coal, and 385,000 tons was charcoal iron, the proportions being about 50 per cent. anthracite, 30 per cent. coke or raw soft coal, and 20 per cent. charcoal pig.

The production of rails amounted to 775,733 tons, against 620,000 in 1870, the increase being 25 per cent. Pennsylvania of course led, producing 43 per cent. of the entire amount, Illinois coming next with 11¼ per cent., New York 11¼ per cent., Ohio 9¼ per cent., Maryland 6 per cent., Massachusetts and Wisconsin 3¾ per cent. each, Michigan, Maine and Indiana a little more than 1½ per cent. each, Tennessee, Missouri and Georgia as much as or a little more than 1 per cent. each, and New Jersey, Kentucky and West Virginia, the only other producers, less than 1 per cent. each. There were in the country forty-eight rail mills with an aggregate annual capacity of about one million tons. The total production of 1871 was enough to lay about 9,000 miles of track with rails of the average weight used.

The rail product was greater than that of all other rolled and hammered irons combined, the latter being reported at 710,000 tons.

The enormous increase in production of anthracite coal (amounting so far this year to more than three million tons more than in 1871) and its consequent low price, together with the unexampled prices of and large demand for manufactured iron this season, may be expected to stimulate the production of iron the current year far beyond anything known heretofore.

THE *Engineer* states that a passenger car of an express train recently lost one of its wheel tires and ran "something like twenty-five miles without getting off the line, or causing a serious catastrophe."

A correspondent of the Birmingham *Post* writes that recently one of the trains from Liverpool, "which usually stops at Northwich, did not stop there; but on arriving at a point on the line between Northwich and Middlewick it slackened speed and finally stopped. After some delay the passengers felt uneasy, and one gentleman walked up to the engine to ascertain the cause of the stoppage, when he found both driver and fireman drunk, and lying asleep on the foot-plates of the locomotive, the steam exhausted, and the fire out." The correspondent added that the driver and fireman have both been suspended. Most readers will feel that if they had received their deserts, their suspension would have been by their necks.

THE GENERAL TICKET AGENTS' ASSOCIATION, at its March meeting, adopted a resolution to the effect that allowed claims for lost baggage checked over two or more lines shall be paid for *pro rata* by the several lines when it cannot be determined on which road the loss occurred, appointed a committee to prepare a table of commissions between principal points (whose report was accepted), and passed resolutions recommending the exclusive use of the modern contract form of coupon tickets, with the official signature on the contract only, and a plain statement on each coupon or auditor's check attached that it will be forfeited if detached, for the protection of local traffic. It was also determined to have the meetings, both annual and semi-annual, begin on the last Fridays of March and September, instead of the last Wednesdays, as heretofore. A revised schedule of rates was adopted, to take effect May 1.

A CORRESPONDENT writing from Woodstock, Canada, says that if railroad managers will put more men to work on the road-bed they will have fewer broken rails and greater safety for life and property, and may run trains twenty-five or thirty-five miles an hour with safety. When the road and rails are bad, he says, the rolling stock must suffer. All of which is doubtless very true. "Economy" in maintaining road often means the rapid destruction of rolling stock, frequent broken rails, and occasional slaughters. The very essence of a railroad is a smooth and solid track, that being all that distinguishes it and gives it an advantage over a common road. We respectfully suggest that those managers who have determined to reduce operating expenses at any rate begin elsewhere than with the road-bed.

THE WESTERN AND SOUTHERN RAILWAY ASSOCIATION, at its recent session in Atlanta, Ga., discussed the questions appointed for the meeting and adjourned to meet at the Kennard House, Cleveland, July 9. Among the questions discussed were: The best means of preventing accidents; responsibility of railroads for injuries to employees; interchange of cars, mileage and demurrage; the maintenance of agreed rates and contracts; sleeping car and express contracts; brakes and platforms; height of car buffers; breakage of rails and axles; national time; repairs of foreign cars, etc.

THE ERIE RAILWAY COMPANY has decided to lay a third rail between New York and Buffalo, so as to form a track of standard gauge which will enable the company to connect with the railroad system of the country, and doubtless be of great advantage to it. But the report is that a considerable mortgage, to the amount of forty million dollars, will be issued to pay for this and "other improvements," which doubtless is a mistake, as the total expense of such a change on the main line, where alone a third rail is needed, could not be more than five millions, and forty millions would be about sufficient to construct two new roads between New York and Buffalo.

THE SCIENTIFIC AMERICAN relates that an old gentleman recently attempted to set the time of his watch by a thermometer which was arranged in a railroad car with a dial and hands like a clock. The difficulty of keeping correct time, if compared with such a standard, can only be realized by those who have suffered from the variable temperature of ordinary cars. The name of the road where this occurred is not given, and nearly all who read of the incident would doubtless like to know what railroad company has thus given indication of its interest in the comfort of its passengers.

The Master Mechanics' Association.

The following important announcements are made to members of the American Railroad Master Mechanics' Association by the committees. The first, concerning the change in the time of holding the meeting, is from the General Supervisory Committee, and is dated April 16:

TIME OF MEETING.

GENTLEMEN: The General Supervisory Committee having received a number of communications from members, asking that the time of annual meeting be made later than that fixed by the constitution, circulars have been sent out to the members to obtain an expression of opinion on that subject. Of the whole number of answers received one hundred and twenty-four are for the change, eight opposed.

Hotel accommodations cannot be obtained for the 18th of the month. Your committee therefore give notice that the fifth annual meeting will be held June 11, 1872, in the city of Boston.

H. M. BRITTON,
N. E. CHAPMAN,
J. B. PENDLETON,
J. H. SETCHEL, } *Committee.*

HEADQUARTERS IN BOSTON.

The Committee of Arrangements report the place selected for the headquarters of the Association as follows:

GENTLEMEN: The Committee of Arrangements for the next annual meeting respectfully beg leave to report that they have selected the American House, Boston, where ample accommodation will be provided for members of the Association.

Those members who will be accompanied by ladies will please give notice to the committee as early as May 1.

Very respectfully,

JNO. THOMPSON,
F. A. WAITE,
GEO. A. COOLIDGE, } *Committee.*

Direct communications to JNO. THOMPSON, Master Mechanic Eastern Railroad, East Boston, Mass.

PROMOTION OF FIREMEN.

The undersigned were appointed a committee, at the last annual meeting of the American Railway Master Mechanics' Association, to inquire into the propriety of a uniform system of examination for promotion of locomotive firemen. Also as to the advisability of establishing different grades of locomotive engineers, according to length of service, character, etc. We desire the benefit of your experience in making up our report, and respectfully request answers to the following questions:

What is your method of promoting locomotive firemen to engineers?

What has been your experience as to the merits of locomotive engineers promoted from firemen or taken from the shops?

What are your views upon establishing different grades of engineers, according to length of service, merit, etc.?

Please state compensation allowed engineers, whether paid by month, trip or day; also amount of service rendered for same?

Any further information you may please to communicate upon the above subject will be thankfully received by,

Yours respectfully,

N. E. CHAPMAN,
W. F. SMITH,
JAS. SEDGLEY, } *Committee.*

Please address your replies to N. E. Chapman, Cleveland, Ohio.

NEW PUBLICATIONS.

Business Album of the Michigan Bridge and Construction Company.—This company has recently issued a handsome volume containing photographs and descriptions of bridges constructed by it, with an appendix giving tables, formulas, etc., such as are of special value to those who have to proportion the parts of framed structures. There are thirteen photographs, beginning with a Howe truss of 100 feet span, and followed by combination double Warren girder, an iron truss bridge of 150 feet span, an iron girder bridge of three spans, a deeper iron girder of 60 feet span, a braced girder bridge of three 70 feet spans, an elliptic "bow-string" bridge, specially designed for carrying roads over railroads, etc., a suspension bridge of 400 feet span, with *wood* towers; a section of wooden trestle work, with a wooden "Foreman truss" bridge of short span, a section of high trestling, a large station roof of curved outline, and frames for two wooden roofs with iron tie rods. Of course such a collection of designs is interesting and valuable to engineers and contractors, and doubtless those who receive it will value it, preserve it, and remember the company which publishes it.

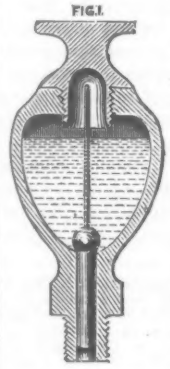
Poor's Manual of Railroads.—This invaluable manual will appear this year, we are informed, about the middle of May, and advertisements will be received until the 5th of that month, as well as subscriptions. The office is at No. 68 Broadway, New York.

Fernon's Fortnightly.—We learn that Mr. Theodore S. Fernon, who was formerly the editor of the *United States Railroad and Mining Register*, of Philadelphia, and has been intimately acquainted with the history of railroads, in Pennsylvania especially—of which, indeed, he was a part—is about to establish a journal with the above name, which, according to the prospectus, will treat chiefly of transportation, mines, manufactures, finance and the mechanic arts. Mr. Fernon's special knowledge of corporations, and especially Pennsylvania corporations, will enable him to make a journal of much interest and value. The first number is to appear in May, being issued in Philadelphia and New York.

Shaw & Boardman's Patent Pneumatic Valve Lubricator.

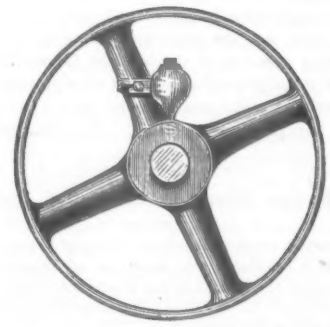
This invention is an improvement upon the ordinary pneumatic lubricators, and introduced and manufactured solely by Messrs. Shaw & Co., of Mill Street Works, Pendleton, near Manchester. Practical objections and difficulties in the effective fixing and working of the open tubed and the needle lubricators in common use, led the patentees to devise means of obviating these defects, and especially of improving the method of regulating the flow of oil from the bottle; which is similar to that of the needle lubricator. There is usually a wooden stopper or plug with a metal tube inserted therein; but, in lieu of a wire or needle being placed in the tube, which, by its continued friction, ultimately cuts a groove in the shaft, on which it rubs, a peculiarly shaped valve is seated on the inner end of the oil passage, as shown in fig. 1. When the shaft is in motion, its slightest vibration causes an oscillation of the ball of the valve in its seat, thereby permitting the lubricant to flow down the tube in minute quantities. But the valve is stationary, and the oil ceases to flow when the shaft is not in motion.

FIG. 1.



One of the most useful applications of this principle is as a lubricator for the oiling of the bearings of loose pulleys, for which it is particularly adapted, and an efficient and economical lubricator for this purpose has long been a desideratum for users of machinery. It is estimated that, in a general way, as much as 75 per cent. of the oil used in oiling the bearings of loose pulleys by hand flows away from the bearings without producing any useful effect, and it is scattered about by the revolutions of the pulley, causing dirt, inconvenience and waste; moreover, oiling by hand is attended with danger. Our illustrations show at fig. 1 the adaptation of the patent pneumatic valve lubricator to loose pulleys. It will be seen that the oil passage is fitted with a small plunger on which a valve is formed, accurately fitted to a seating that closes the inner end of the passage. When the loose pulley is running, it imparts a slight motion of vibration to the plunger, with corresponding oscillations of the valve that permit a small quantity of oil to flow, while waste or excessive supply is effectually prevented.

FIG. 2.



In fig. 2 is shown another adaptation of the same lubricator, to be attached to an arm of the pulley. The same kind of lubricator is also manufactured in brass, of different sizes, for engine cranks, and in this form has met with universal approval where tried. The action of these lubricators is certain and unfailing, so long as there is a supply of oil—it is intermittent, ceasing entirely when the working parts lubricated thereby are at rest—it is but little, if at all, affected by variations of temperature; finally, it is economical, alike in first cost and in working, durable and easily affixed, or substituted in lieu of the needle or other lubricators with plugs or tubes that can be taken out, for which purpose valves are supplied separately; and as no part of the lubricator touches any shaft to which it is applied, damage to the shaft by wear is avoided.

The principle and action of this invention have undergone long-continued and severe tests during the last twelve months, and among many who have tried and found them worthy of adoption may be mentioned Messrs. Platt Bros., the eminent machinists of Oldham, whose machinery assumed so prominent a place in the western avenue of the International Exhibition at South Kensington, last year.—*Mechanics' Magazine.*

Improvement of the Steam Engine.

In a paper read before the Polytechnic Association of the American Institute by Professor Thurston, on the above subject, he summed up his conclusions in the following statements:

The direction which improvement seems now to be taking, and the proper direction, as indicated by an examination of the principles of science, as well as by our review of the steps already taken, would seem to be:

Steam must enter the machine at the highest possible temperature, must be protected from waste and must retain, at the moment before exhaust, the least possible amount of heat. He whose inventive genius, or mechanical skill, contributes to effect either the use of higher steam with safety and without waste, or the reduction of the temperature of discharge, confers a boon upon mankind.

In detail: *In the engine*, the tendency is, and may probably be expected to continue, in the near future at least, toward higher steam pressure, greater expansion in more than one cylinder, steam jacketing, superheating, a careful use of non-conducting protectors against waste, and the adoption of higher piston speeds.

In the boiler, more complete combustion without excess of air passing through the furnace, and more thorough absorption of heat from the furnace gases. The latter, I am inclined to suppose, will be ultimately effected by the use of a mechanically produced draught, in place of the far more wasteful method of obtaining it by the expenditure of heat in the chimney.

In construction, we may anticipate the use of better materials and more careful workmanship, especially in the boiler, and much improvement in forms and proportions of details.

In management, there is a wide field for improvement, which improvement we may feel assured will rapidly take place, as it has now become well understood that great care, skill and intelligence are important essentials to the economical management of the steam engine, and that they repay liberally all of the expense in time and money that are requisite to secure them.

Chicago Railroad News.

Michigan Central.

This company is about commencing the construction of a general office building at the foot of Lake street, either on the foundation of the old building or near it. The company has not yet decided whether it will not enlarge its freight house, extending it over the ground of the old office structure. Should it do this, the plans of the office building will be such that the building will be somewhat more commodious than the old one.

There will be a slight change of time on some of the local trains of this road about the 5th of May. The change will affect particularly the Michigan roads, and will tend to make their connections more perfect. At that date the train connecting with the Michigan Lake Shore road for St. Joseph, Muskegon, Pentwater, etc., will be the day express that leaves this city at 9 o'clock in the morning, instead of the train that leaves at 6 o'clock p. m.

At the same time, the company will put on through sleeping-cars from Detroit by way of Jackson and Grand Rapids to Muskegon and Pentwater.

The company is pushing forward the work on the second track between Lake Station and Niles with great energy, large forces of men being employed at several points. The second track is to be all steel.

Illinois Central.

Contracts have already been agreed upon between this company and the Mississippi Central, whereby a short section of road is to be built between Cairo and Jackson this season, thus giving the Illinois Central an opportunity to run through trains to New Orleans. The terms are all settled in regard to the bonds to be issued for the accomplishment of the work, and the contracts await the signature of the contracting parties, which will take place this week, when the details of the agreement will be made public.

Chicago, Burlington & Quincy.

This road will open to Clinton, Iowa, for business next week.

Chicago, Rock Island & Pacific.

The celebration of the completion of the Leavenworth Bridge across the Missouri River took place on the 18th inst. at Leavenworth. Large numbers of people were in from Missouri and Kansas to witness and take part in it. Trains were run every half hour from the fort grounds, at the west end of the bridge, to the city. In the evening a ball took place. The celebration, in all respects, was a fine affair. The general management of the trains on the Southwestern Branch was under the direction of Mr. A. M. Smith, General Passenger Agent. The bridge is a tubular bridge, very similar in construction to the Omaha bridge. There is, on the Missouri side, a long approach of about three miles to the river, before the bridge proper is reached. The bridge terminates on the grounds of Fort Leavenworth, and connection with Leavenworth at present is by way of the Missouri Pacific; but the company are discussing the question of building a short line to the city limits. When this question shall be decided, it will proceed to erect freight and passenger houses. One through train each day is at present run on the Southwestern Branch. At the opening of summer another will be added.

The Atchison Branch of the Southwestern, which leaves that line three miles west of Edgerton, and will require a road about 29 miles in length, is being pushed forward rapidly toward completion. The 15th day of May is set for finishing the work. The Atchison Bridge is in process of construction, and will be done during the summer. When it is done, the Chicago, Rock Island & Pacific will have a connection with the Atchison & Nebraska road to Lincoln, since the latter road is to be completed to Lincoln within two months. It will also have connection with the Central Branch Union Pacific, which runs from Atchison to Waterville, a distance of 100 miles. The Atchison, Topeka & Santa Fe road will also then be completed to a point near the Indian Territory, which will make the Chicago, Rock Island & Pacific a short route between Chicago and that Territory. The link between Atchison and Topeka will be completed about the 15th of May, and trains are now running from Topeka to Newton, which is the present southern terminus of the line.

These new connections promise to add quite largely to the freight business of the Chicago, Rock Island & Pacific road, especially in the item of Texas cattle. During the past winter it is said upon good authority that 400,000 Texas cattle have been herded at Newton awaiting shipment to Chicago on the Atchison, Topeka & Santa Fe and Rock Island roads.

Chicago & Alton.

The receipts of this road for the week in April ending the 15th were $102,435.48. For the corresponding week last year, the receipts were $102,432.35, a difference of only $3.13 in favor of 1872.

Lake Shore & Michigan Southern.

This company has already got two coal-burning engines running from this city eastward—the engines that take the Pacific and Atlantic express trains.

Mr. F. E. Morse, the General Passenger Agent, returned, after a somewhat protracted visit to California, on the 24th inst.

H. H. Blodgett has been appointed Assistant Engineer with office at La Porte. He will have charge of the Western Division of the road, the same as before.

The company, in order to avoid confusion, occasioned by similarity of names on other points of their road and branches, have just made the following changes in the names of stations: Western Division—Illinois Central Railroad Crossing to Grand Crossing. Toledo Division—Berlin to Ceylon. Kalamazoo Division—West Watson to Abronia; Silver Creek to Argenta; Parkville to Moorpark. Detroit Division—Huron to Rockwood.

By a recent arrangement the trains which leave Chicago at 6:40 a. m. and 9 p. m. make connections for Detroit, and those leaving at 9 a. m. and 9 p. m. make connections for Kalamazoo and Grand Rapids.

Chicago & Pacific.

The Atlantic & Pacific Company assume this new name on the first of May, with its office at No. 374 Wabash avenue. A recent act of the General Assembly gives the company the power to change its name, after a notice of 30 days. The construction of the road to the Desplaines is to commence in May. The company has contracted for 100,000 ties, which are to be delivered in May. A construction locomotive and construction train have been purchased, and two passenger and baggage cars. Upon the completion of the road to the Desplaines, it is designed to run a suburban train to that point every hour.

The line of the track within the city has been somewhat changed, and will probably be adopted by the Common Council as now proposed, since it is less objected to on the part of property-owners within the city. The passenger track will run along the east side of the North Branch, on Kingsbury street and Hawthorn avenue to Jones avenue, and on Jones avenue to Armitage road, and on Armitage road to the city limits. The Mississippi River terminus has not yet been fixed; but it will be some point between Clinton and Galena. The officers are: President, Colonel R. M. Hough; Vice-President, T. S. Dobbins; Treasurer, C. F. Bowen; Secretary, W. T. Hughes; Engineer, J. M. Raymond. Directors, George S. Bowen, Harry Fox, W. L. Pease, John S. Wilcox, George Youngs.

Chicago & Northwestern.

It is reported that this company will commence the construction of a line from Lodi to Milwaukee early in May, and that it has secured an entrance into Milwaukee from the north, running for some distance on a pier in the lake at a little distance from the shore.

The route decided upon for the Madison Extension west of Sparta is very nearly parallel with the Milwaukee & St. Paul to the junction with the La Crosse, Trempealeau & Prescott road, a few miles northeast of La Crosse. The contract for the section west of Bangor, about twelve miles, is let to D. J. Cameron and L. Rossiter, of La Crosse.

Continental Railway.

This company opened the bids on Monday, at the Briggs House, for the construction of 300 miles of its road—the portion between this city and Tiffin, Ohio. The President of the company, Edward E. Dodge, and the President of the Central Construction Company, James E. Abbott, with some other railway officials interested, were present.

General Railroad News.

TRAFFIC AND EARNINGS.

—The receipts of the Great Western Railway of Canada for the week ending March 22 were: 1872, £22,279; 1871, £20,095; increase, £2,184, or 10¼ per cent.

—The earnings of the Hannibal & St. Joseph Railroad for the month of March were: 1872, $214,302.03; 1871, $293,436.15; decrease, $79,134.12, or 27 per cent.

—The earnings of the St. Louis & Iron Mountain Railroad for the first week of April were: 1872, $44,686.00; 1871, $35,920.61; increase, $8,765.39, or 25¼ per cent.

—The Kansas Pacific Railway Company report its earnings, partly estimated, for the first week of April as $40,409.80 from freight and $32,615.79 from passengers, a total of $73,025.59.

—The earnings of the St. Louis & Iron Mountain Railroad for the second week of April were: 1872, $46,695; 1871, $32,209.41; increase, $14,485.59, or 45 per cent.

—The earnings of the Indianapolis, Bloomington & Western Railway for the first week of April were $30,110.13.

—The earnings of the Chicago & Alton Railroad for the second week of April were: 1872, $102,435.48; 1871, $102,432.35—an increase of $3.13.

— he receipts of the Grand Trunk Railway of Canada for the week ending April 6 were: 1872, £34,200; 1871, £32,100; increase, £2,100, or 6½ per cent.

—The receipts of the Great Western Railway of Canada for the week ending April 5 were: 1872, £24,016; 1871, £19,516; increase, £4,500, or 23 per cent.

ELECTIONS AND APPOINTMENTS.

—Mr. John Schuyler, Chief Engineer of the Hudson River & Port Chester Railroad, having resigned, Mr. Charles Newman, late Superintendent of the new railroad bridge at Albany, is to take charge of the work.

—At the annual meeting of the Shenandoah Valley Railroad Company, held at Front Royal, Va., on the 9th inst., Colonel Thomas A. Scott was re-elected President, with the following board of directors: Colonel Jonas M. Walker and Major George H. Bardwell, of Philadelphia; Hon. W. H. Travers and Hon. A. R. Boteler, Jefferson County, Virginia; Colonel A. W. McDonald and Colonel U. L. Boyce, Clarke County; M. B. Buck, Esq., Warren County; Hon. Wm. Milnes, Jr., Hon. John W. Ashby and Colonel Mann Spitler, Page County; H. B. Hansberger, Esq., Rockingham County.

—At the annual election of the Peoria, Atlanta & Decatur Railroad Company, held in Peoria, April 8, the old board was re-elected, consisting of John T. Lindsay, W. H. Cruger and R. G. Ingersoll, of Peoria; W. S. Dunham, of Atlanta, and J. Burwell, of Mackinaw. Another ticket, which received the votes of the Peoria stock, dropped the names of Lindsay and Cruger and substituted those of A. N. Dill, of Atlanta, and John Waugh, of Peoria. This Peoria stock had been a majority, but at the election C. A. Storr, President of the Toledo, Peoria & Warsaw, appeared as the owner of 200 shares, for which he had been permitted to subscribe without the knowledge of the Peoria representative. The latter claims that this issue, and consequently the election, is illegal.

—At the meeting of the Hannibal & Central Missouri Railroad Company on the 3d, the following directors were elected to serve for the ensuing year: Azariah Boody, New York; George Cecil, Logansport, Ind.; A. M. White, New York; John N. Drummond, Toledo, O.; Abram B. Baylis, New York; A. W. Lamb, Hannibal, Mo.; Isaac H. Knox, New York; J. F. Hawkins, Hannibal; Wm. Kidd, New York; David H. Moss, David L. Cooper, Paris, Mo. All of these except Messrs. Lamb, Hawkins, Moss and Cooper are directors of the Toledo, Wabash & Western Company, which leases and operates the Hannibal & Central Missouri.

—At a meeting of the newly organized St. Louis, Jerseyville & Springfield Railroad Company held in Jerseyville, Ill., on the 11th of April, the following officers were elected: Hon. Hugh N. Cross, President; Hon. Orlin H. Miner, Vice-President; Morris R. Locke, Secretary; Milton D. Robbins, Treasurer; and Hon. Robert A. King, Attorney. The Executive Committee, consisting of the President and Col. Charles W. Matheny, of Springfield; Hon. W. H. Allen, of Grafton, and Hon. Henry A. Goodrich and James A. Locke, of Jerseyville, were authorized to have the route surveyed immediately.

—Mr. T. Penfield has been appointed General Passenger and Ticket Agent of the Rockford, Rock Island & St. Louis Railroad, with headquarters at Rock Island. Mr. J. N. Conger, who has held that position, as well as the general freight agency, remains in the latter position.

—J. S. Day, late General Freight Agent of the Louisville, New Albany & Chicago Railroad, has been appointed Assistant Superintendent by the Receiver.

—The following gentlemen have been elected officers of the St. Louis, Salem & Little Rock Railroad Company: President, A. L. Crawford, Newcastle, Penn.; Directors, C. C. Simmons, St. Louis; H. A. Crawford, Newcastle, Penn.; W. L. Scott and W. Brewster, Erie, Penn.; Chief Engineer, E. B. Sanker.

—At the annual meeting of the Chicago & Michigan Lake Shore Railroad, held in Muskegon, Mich., on the 9th inst., Hon. James F. Joy, Hon. A. H. Morrison, Martin L. Sweet, Freeman Godfrey, Chauncy Davis, Samuel R. Sanford, Thos. Hefferam, Samuel A. Brown and Delos L. Filer were unanimously elected directors for 1872. The following officers were elected: Hon. James F. Joy, President; Hon. A. H. Morrison, Vice-President and General Manager; Isaac Livermore, Boston, Treasurer; J. M. Barnett, Grand Rapids, Mich., Secretary.

—Mr. S. B. Carter, well known in connection with various Illinois railroads, and last year Chief Engineer of the Decatur & State Line Railroad, is now engaged on the New York & Chicago Air Line.

—The board of directors of the Saginaw & St. Clair Railroad Company have elected W. H. Warner, of East Saginaw City, and A. W. Wright, of Saginaw City, in place of Messrs. George W. Peck and J. L. Ketchum, resigned. The board of directors as it now stands is as follows: President, J. E. Shaw; Treasurer, C. K. Robinson; Secretary, J. F. Fundy; Directors, E. P. Sears, M. Jeffers, W. H. Warner, A. W. Wright. The regular annual meeting to elect a new board of directors will be held early in May.

—H. H. Blodgett has been appointed Assistant Engineer of Lake Shore & Michigan Southern Railway, in charge of the Western Division, with headquarters at Laporte, Ind.

—George W. Phelps, Superintendent of the Avon, Genesee & Mount Morris Railroad, has been elected Superintendent of the Connecticut Western Railroad.

OLD AND NEW ROADS.

Massachusetts & Rhode Island.

Preliminary steps have been taken to secure the construction of a railroad of this name from Worcester, Mass., southeast a little distance east of the Providence & Worcester Railroad to Franklin, Mass., and thence nearly due south to tide-water at India Point, opposite Providence, where it is said that there are extraordinary facilities for receiving coal and other heavy freights. Mr. G. H. Stone, the engineer, reports that from Worcester to Milford, 21 miles, a favorable route has been found, by which the estimated cost of a road of standard gauge will be a little less than $27,000. Harvey Chace, of Valley Falls, R. I.; Edwin Darling, of Pawtucket, R. I.; James Ray, of Franklin, Mass.; Stephen Richardson, of Attleboro, Mass.; Isaac H. Southwick, of East Providence, R. I.; Samuel Walker, of Milford, Mass.; W. W. Dutcher, of Hopedale; Velorous Taft and T. J. Hall, of Upton; Winthrop Faulkner and J. H. Wood, of Grafton; Wm. E. Rice, John S. Baldwin and P. Emory Aldrich, of Worcester; and C. W. Green, of Fall River, were chosen directors.

Plymouth, Kankakee & Pacific.

There have been some internal dissensions for some months past, which have prevented this company completing the work it intended; but recently old difficulties were amicably settled, and this company now has its bonds in the market in Europe, and expects to be able to complete its road with dispatch.

New Maryland Railroads.

The following companies have filed their certificates of incorporation:

The Baltimore, Catonsville & Elysville Steam Railroad Company. The termini of the road are the city of Baltimore and the village of Elysville, in Howard County, and the road is to pass through Catonsville and Union Mills, Baltimore County. Capital stock, $250,000.

The Vienna Railroad Company. The termini of the road are Vienna, Dorchester County, and a point on the line of the Dorchester & Delaware Railroad, at Hurlock's Station, or Linkwood Station, or intermediate between the two. Capital stock, $100,000.

The Hookstown & Pimlico Branch of the Catonsville & Powhatan Railroad Company. The termini of the road are the intersection of the Liberty road and Madison avenue, by way of Hookstown, to the grounds of the Maryland State Agricultural Society, Pimlico. Capital stock, $18,000.

The Randallstown Branch of the Baltimore, Catonsville & Powhatan. The termini of the road are the point where the Hookstown & Pimlico Branch of the Baltimore, Catonsville & Powhatan Railroad crosses the Liberty turnpike road to the village of Randallstown, in Baltimore County. Capital stock, $10,000.

The Middletown & Elkton Railroad Company. The termini of the road are Elkton, Cecil County, and some point on the line dividing the States of Maryland and Delaware, south of the Chesapeake & Delaware Canal, to connect with a road from Middletown, New Castle County, Delaware. Capital stock, $250,000.

Cape Cod Railroad.

This company is about to be consolidated with the Old Colony & Newport Company, the new company to be known as the "Old Colony Railroad Company." Shareholders in the Cape Cod Company may either receive 17 shares of new for 23 of their stock or $75 per share, at their option. The Cape Cod road with its branches is 72 miles long.

Rutland Railroad.

In order to free this company from its floating debt, a subscription by the stockholders to preferred stock is asked, and at a recent meeting in Boston a large amount was subscribed. To become binding, these subscriptions must be closed by the 1st of May.

Lake Ontario Shore.

There is difficulty about the subscriptions of bonds to this company by some towns on the lake shore in Niagara County, the taxpayers having sued for injunctions to restrain the issue; and it is possible that this may result in the abandonment of the lake shore line and the adoption of one through the canal towns west of Rochester.

Buffalo & Titusville.

By a vote of 9,020 to 2,171, Buffalo decided on the 16th to subscribe in aid of this road.

Baltimore & Ohio.

At the recent monthly meeting of this company it was announced that a semi-annual dividend of 5 per cent. would be made on the stock of the main stem and the Washington Branch, and that probably this rate can be maintained hereafter. The rate heretofore has been 4 per cent. As the city of Baltimore holds $3,250,000 of these stocks, for which it issued its bonds on which it pays 6 per cent., its income from the stock will be $325,000 yearly, or a profit of $130,000. The President took occasion to contrast the profitableness of this investment of the city with the losses in its investments in the Northern Central and the taxation imposed by its investments in the Western Maryland. Mr. Garrett also announced that the North German Lloyds had determined to add two new and large steamers to those it now has plying between Baltimore and Bremen, and that the business of the Allan steamers now plying between Liverpool and Baltimore is increasing.

Shenandoah Valley Railroad.

At the annual meeting, April 9, a letter was read from Thomas A. Scott, the President, explaining the delay of the past six months, and promising that if owners of property on the line would act liberally toward the company, the work would now go on.

Chesapeake & Ohio.

One of the largest tunnels on this line, that at Second Creek, about eight miles from Lewisburg, being 1,671 feet long, was driven through on the 6th inst.

Mansfield & Wheeling.

The certificate of incorporation of this company has been filed in the office of the Secretary of State of Ohio. It has been organized to construct a road between Mansfield and Wheeling, through Richland, Ashland, Holmes, Tuscarawas, Coshocton, Harrison, Jefferson and Belmont counties. The capital stock is $1,000,000.

Newark & Straitsville.

The long tunnel on the southern part of this road is now completed, and the road will soon be completed to the coal mines at Straitsville.

Cleveland & Pittsburgh.

This company has been making preliminary surveys for a bridge across the Ohio opposite Wheeling.

Louisville, New Albany & St. Louis.

This company has recently concluded the purchase of 27 acres of land in New Albany on which to build its construction and repair shops.

Erie & Pittsburgh.

The abandonment of the old Erie & Pittsburgh Canal having left the towns on its line without transportation facilities, they are making an effort to induce this company to change their line to the canal route from Erie to Greenville, 63 miles, by which it is said that it will reach more considerable towns and get easier grades

Cleveland, Mount Vernon & Delaware.

Work is begun at Mount Vernon, Ohio, at the western end of this road. It is to be completed by the 1st of June.

Baltimore Steamer Lines.

The Baltimore *Sun* says: "We have now in regular operation a line of five first-class steamships to Bremen, with two more now building, making an aggregate tonnage of 17,500; a line of five steamships to Liverpool, aggregating 12,500 tons, and four of the West India mail steamers, with an aggregate tonnage of 10,000, calling regularly at this port for return cargoes to Liverpool. These make a total of 16 steamships in the foreign trade of the port, beside the two ships in the New Orleans trade, which stop at Havana going and returning. There are also six steamers in the trade of Boston, 6,870 tonnage; four in the Savannah line, 2,338 tons; three to Charleston, 1,818 tons; four to Wilmington, 2,239 tons, and three to other North Carolina ports, 956 tons. Thus there are sixteen steamers in the foreign trade, aggregating 13,616 tons. This exhibit gives Baltimore a total tonnage of sea-going steamers of 53,616 tons."

New York & Chicago Air Line.

Mr. S. B. Carter, late Chief Engineer of the Decatur & State Line Railroad, is making some preliminary surveys for this company in Ohio west of Tiffin.

Continental Railroad.

Engineers are making surveys for this line from Tiffin, O., to Fort Wayne, Ind. It is intended to make the route an air line from Tiffin to Rensselaer, near the western border of Indiana, and to have a branch to Chicago. Joseph McWilliams is Chief Engineer, and Charles Stewart, late of Rockford Central, is in charge of a division.

Adrian & State Line.

This company was recently organized in Adrian to take charge of the Michigan section of a projected line from Adrian, Michigan, west by south to Kokomo, Ind., being substantially a branch of the Detroit, Hillsdale & Indiana.

Atchison & Nebraska.

The track is laid as far as Tecumseh, Neb., 99 miles from Atchison, and work is progressing on the branch from Arrow Rock to Pawnee City.

St. Joseph & Denver.

It is reported that this company has purchased the Wathena & Doniphan Railroad, which would give it a terminus at Atchison as well as St. Joseph.

Port Royal & Augusta.

McCallahan & Co. have taken a contract to build 36 miles of this road, from Augusta southeast to Steel Creek, the remainder being already in progress.

Hawkinsville & Eufaula.

The route proposed for this road is from Hawkinsville, Ga., west by south 120 miles to Eufaula, Ala. Such a line would enable the Macon & Brunswick road to get traffic in Southwestern Georgia, where now the Central of Georgia has no competition. It is reported by Georgia papers that German capitalists have subscribed $1,500,000 for the road, and New York capitalists $700,000, and that when $300,000 has been subscribed by the counties on the line the road will be built.

Memphis & Knoxville.

This company purposes to let contracts for the construction of the 33 miles of their road (narrow-gauge) between Memphis and Macon, Tenn., very soon. Bolivar and Somerville are also to be points on the road.

Mobile & Northwestern.

The Helena *World* says that the road-bed, except some bridging, for 18 miles of this road from the Mississippi opposite Helena southeastward, is completed, that 12 miles more will be soon, and that iron enough for 30 miles has arrived at New Orleans. Efforts are making to secure subscriptions enough to insure the immediate beginning of the work between Jackson and Yazoo City.

Helena & Iron Mountain.

The Little Rock (Ark.) *Gazette* reports that 17 miles of this road is graded and the ties on the line, and that work will be commenced at Helena directly. The road is intended to connect Helena with St. Louis by what will be in effect a branch of the St. Louis & Iron Mountain road.

San Antonio & Mexican Gulf.

The contract for the extension of this railroad from Indianola, Texas, northward to San Antonio has been let to Capt. Gustav Schleicher and Col. E. H. Cunningham, of San Antonio. From Indianola to Cuero the road is to be completed in six months.

Denver and Rio Grande.

Track laying is begun on the second division of this railroad, between Colorado Springs and Pueblo, and it was expected that it would be ready for trains by May.

San Francisco Passenger Traffic.

The San Francisco *Bulletin* gives the following suggestive statements of the passenger traffic of that city. The following is the number of through passengers on the Central Pacific Railroad for March. The number compares as follows with the same month in previous years:

March.	Arrived.	Departed.
1870	2,798	1,305
1871	2,086	1,466
1872	1,394	1,322

Passenger arrivals by way of the sea for the same month compare as follows:

March.	Arrived.	Departed.
1870	1,916	923
1871	779	597
1872	860	602

The monthly arrivals and departures by both routes for the first quarter of the year have been as follows, to which are appended the totals for the same time in previous years:

	—Per ocean routes.—		—Per C. P. R. R.—	
1872.	Arrived.	Departed.	Arrived.	Departed.
January	823	866	828	787
February	980	710	846	400
March	860	682	1,394	1,322
Totals	2,663	2,258	3,068	2,509
Same time, '71	1,868	1,744	4,251	3,583
Same time, '70	3,953	2,787	5,525	3,158

"The arrivals by both routes for the past quarter aggregate 5,731, against 4,767 departures, an increase of nearly 1,000 to our population. During the same quarter in 1871 the arrivals were 6,119, and the departures 5,327, a gain of 800; while for the first quarter of 1870 the arrivals were 9,478, and the departures 5,945, showing a gain of over 3,500. The light traffic by rail during the past quarter is accounted for by the fact that the Union Pacific road was blocked by snow from four to six weeks in January and February. Of the 2,663 arrivals by water this year, 1,049 came from China and Japan, 641 from New York and Panama, 357 from Honolulu, 258 from Australia, 201 from British Columbia, and 107 from Mexico. The departures embraced 1,142 to Panama, 727 to China and Japan, 107 to Honolulu, 123 to British Columbia, 75 to Australia, and 32 to Mexico.

Chesapeake & Ohio.

A correspondent engaged on this road writes to us:

"Work is pushing ahead very rapidly on this railroad, after a very unfavorable winter. The large fills at Millboro' and Jerry's Run, one of them 200 feet high and containing 1,100,000 cubic yards, are both completed, and the headings of the large tunnels about through, except the Lewis Tunnel, around which a temporary track has been in operation for some time. At the Stretcher's Neck Tunnel, the contractors drove 400 feet in two headings in one month. Track-laying will soon be commenced at the eastern end, and it is expected to have the rails laid through by November next. The alignment of the road is unusually favorable, and the grades lighter than the prairie roads of the West, the maximum being thirty feet per mile, with no ascending grade, going west, from the summit of the Alleghanies to the Kanawha River. It traverses the finest coal and iron region in the country, as yet undeveloped, and will make a great change in the commercial and manufacturing interests of the Eastern States. A double-track tunnel under Church Hill in Richmond, designed to give its trains free access to the deep-water wharves in the James River, is being pushed vigorously, and the people of that ancient city are looking forward to the completion of this long-hoped-for connection with the West as the beginning of a new era of prosperity."

Wisconsin Valley.

Work is progressing favorably on this line from Tomah, Wis., northeast toward Grand Rapids, and it is expected that a construction train will soon commence laying track. The road is to be completed to Grand Rapids next fall, if possible.

Sabula, Ackley & Dakota.

Arrangements have been made for the immediate extension of this railroad from its present terminus at Oxford Junction (on the main line of the Davenport & St. Paul road) westward to Marion, about 30 miles, for which distance it will be from four to nine miles north of the Chicago & Northwestern, and about eight miles south of the Iowa Midland. The Sabula, Ackley & Dakota is now 52 miles long, and is graded from Oxford Junction to Rome, nine miles. It is intended to extend the road from Marion northwest to Vinton, on a line a few miles east of the Burlington, Cedar Rapids & Minnesota, and, eventually, thence west between the Northwestern and the Dubuque & Sioux City roads.

Grand Rapids & Indiana.

The Detroit *Tribune* says: "It is stated that the contract for grading the whole line of the Grand Rapids & Indiana road, from the junction with the Traverse City Branch to the Straits of Mackinaw, has been let to E. B. Talcott & Company. By the terms of the contract nearly 100 miles of new track are to be laid this season, or to a point nearly 75 miles north of Clam Lake, just a little south of Little Traverse. The distance from there to the Straits is but about 30 miles, which will be laid easily in the early part of next summer. This company have just called in $50,000 of the unguaranteed bonds of 1869, thus showing that they have a sinking fund. Work on the line is progressing finely. Nearly all the work that can be done on the grading to the junction, north of Manistee River, before the snow is gone, is completed, and but little except surface work is to be done. Nearly 300 men are now at work on the line, and by May 15 fully 500 will be employed, if not more. The line for the Traverse City Branch has been definitely located. The junction will be near Fife Lake, some five miles northeast of the point first chosen. The branch will be over two miles shorter than by the first survey, and will pass through a better country. It is to be completed to Traverse City by October 1."

Detroit & Bay City.

The Detroit *Tribune* says: "Sub-contracts on the Detroit & Bay City Railroad have been let. The division between Detroit and Utica is to be built by Seymour Brownell. He commenced work on the 9th, and his contract is to be completed in 60 days. The cars will be running to Utica by the 1st of July. The division between Utica and Vassar is to be constructed by the Detroit Bridge and Iron Works, and from Vassar to the Saginaw River by Townsend North. Work under these several contracts will be commenced at once, and pushed forward with all possible speed: The cars are to be running over the road from Detroit to Bay City by November 1."

Grand Rapids Car Company.

The entire stock ($300,000) of this new Michigan company has been subscribed.

Flat River & Houghton Lake.

This company, recently organized in Michigan, purposes a northern extension of the proposed Kalamazoo, Lowell & Northern Railroad.

Canada, Michigan & Chicago.

It is reported that a company with this name has been organized in Michigan recently, with the design of building a railroad from St. Clair to Lansing, there to have intimate connections with the Peninsular. The route is almost identical with that proposed for the Michigan Midland, and if one is built probably the other will not be—or, at least, it both are built, neither will be likely to be worth much.

Detroit, Owosso & Northwestern.

This is the name of a company organized April 11, at Milford, Mich., which is talking of making a railroad from Detroit northwestward to Frankfort, on Lake Michigan, a large part of the route being through a country where railroads are already uncomfortably close together. The following are the officers of the road: President, P. Dean Warner, Farmington; Vice-President, Isaac Crawford, Owosso; Secretary, Henderson Craw-

ford, Milford; Treasurer, George R. Tuttle, Walled Lake.

St. Joseph Valley.

Niles, Mich., has subscribed $20,000 for the construction of this road from Niles to St. Joseph. The amount required from that town is $30,000.

Detroit, Lansing & Lake Michigan.

This company is making preliminary surveys for the western section of its road, from Howard City to Pentwater, which it is intended to complete this year. The route is through heavy pine woods.

Peninsular of Michigan.

Tracklaying on the section between South Bend and Valparaiso is resumed.

Michigan Midland.

The secretary of this company has recently announced that the Lake Michigan terminus has not yet been determined, and probably will not be until the company has complete information concerning the various harbors, but the main effort this season will be to construct the road from St. Clair to Fenton or Byron.

Grand Rapids & Saginaw.

An effort is being made to consolidate this with the Grand Rapids & Bay City Company. It is proposed to have one line in common from Grand Rapids to Midland and thence branches to both Saginaw and Bay City.

North & South Railway.

The Pueblo *People* says that a company of this name has on record a mortgage for $972,000 to the Farmers' Loan & Trust Company on a section of railroad to be constructed from the Kansas Pacific Railway at Kit Carson southwest to the Arkansas at or near Fort Lyon, 54 miles, the bonds being guaranteed by the Kansas Pacific.

St. Clair River, Pontiac & Jackson.

This newly-organized Michigan company succeeds to the property and franchises and purposes of the Michigan Air Line east of Jackson, consisting of about 20 miles of road from Ridgeway westward, considerable local subscriptions and the authority to complete the road to Jackson on the west and St. Clair on the east. The new company leases the property, agreeing to complete the road to Pontiac in one year and to Jackson within three years. The officers of this new company are as follows: Wm. M. McConnell, President; E. B. Comstock, Treasurer; C. F. Kimball, Secretary; M. E. Crofoot, B. G. Stout, H. W. Lord, A. C. Baldwin, Edwin Phelps, A. Parker, M. S. Hadley, D. C. Buckland, T. A. Flower and J. H. Morris, Directors; nearly all from Pontiac.

Logansport, Crawfordsville & Southwestern.

The financial agents, Messrs. Jones & Schuyler, will pay the quarterly gold coupons, maturing May 1, of the first-mortgage bonds of this company, on and after that date, at their office, No. 12 Pine street.

President Tuttle, of Wabash College, Crawfordsville, Ind., has written an enthusiastic letter on the prospects of the line and its value to the country through which it runs, and also highly eulogistic of the leading men in its management.

A strong effort is being made to construct a railroad connecting with this line at Frankfort or some point north, through Kokomo, Jonesboro and Hartford, Ind., and Celina, O., to Lima, O., about 130 miles. This would give a good connection for Toledo and the lake shore cities and also with the East through the Fort Wayne road. The new line is called the "Crawfordsville, Kokomo & Toledo."

Peoria, Atlanta & Decatur.

The Peoria *Transcript* reports that this company has made a contract to lease its road to the Toledo, Peoria & Warsaw Railway Company for 99 years, for a rental of 27½ per cent. of the gross earnings, the latter company to complete the road to Atlanta (35 miles from Peoria) within a year, and to Decatur, 35 miles further, within two years. This lease was agreed upon at a meeting of the Peoria, Atlanta & Decatur Company in Peoria, April 8. At that meeting the representative of the Peoria stock, 100 out of 175 shares, intended to choose a new directory, but he found that without his knowledge Charles A. Secor, President of the Toledo, Peoria & Warsaw, had been permitted to subscribe for 200 new shares, which gave him a majority interest. The meeting then re-elected the old board.

The grading for the road is nearly completed between Peoria and Atlanta; some ties are laid. The road runs southeast from Peoria, making an angle of about 45 degrees with the Toledo, Peoria & Warsaw. It is for the most part parallel with and only ten or twelve miles distant from the Pekin, Lincoln & Decatur Railroad.

Paris & Danville.

Track-laying has begun on this road at Paris. The road will form virtually an extension of the Chicago, Danville & Vincennes road from Danville 35 miles south.

Cairo & St. Louis.

A correspondent writes from St. Louis of this narrow-gauge road as follows: "Everything is moving smoothly and energetically under the management of Colonel C. C. Clute. Depots are being located, rights of way secured, and grading is going on rapidly. Two thousand tons of iron will be on the ground by the 1st of June, and tracklaying will commence at once. There is 40 miles ready for the ties and iron already. They will have the road completed very early in 1873." Colonel E. P. Noyes, late in charge of machinery on the Pacific Division of the Northern Pacific, is Superintendent of Machinery.

Dakota Railroads.

It is hardly correct to say Dakota *railroads* at present, as there is not now a mile of track in that territory, unless, as is possible, the Northern Pacific has made a beginning west of the Red River of the North. But there is a large number of railroad companies, some of which have let contracts. Among the latter is the Dakota Southern, whose line from Yankton to Sioux City is under way, and is to be completed next fall. The "Yankton, Sioux Falls & Minnesota" is organized with the purpose of constructing a railroad from Yankton northwest to Sioux Falls, and thence in Minnesota to a junction with the Sioux City & St. Paul road. Of this company W. H. H. Beadle, Surveyor General of the Territory, is President, and Mr. T. Wooley Engineer, the headquarters being Yankton. The Dakota Central wants to build a railroad from Yankton north by west to a junction with the Northern Pacific about half way between the Red River of the North and the Missouri.

Union Pacific.

The Land Department reports that during February and March, 1872, there were sold 12,639.65 acres of the company's lands at an average price of $4.18 per acre, making an aggregate of $52,844.82. The total sales of the company's land up to the end of March were 517,967.54 acres, at an average of $4.13 per acre, amounting to $2,143,008.52.

The department has already cancelled $960,000 of $10,400,000 land-grant bonds issued, and the trustees have bought them to the amount of $251,000, so that the amount outstanding is reduced to $9,183,000, and the department has land notes outstanding amounting, without interest, to $1,020,855.74.

This company has named its station in Iowa at the eastern approach of the Missouri River Bridge "Lake Station," the same being in the corporate limits of the city of Council Bluffs, but a mile or so from the business center.

Dummy engines, with street cars, are to run across the company's bridge, between the transfer depot in Council Bluffs and the Omaha depot, every half hour.

Nishnabotna Valley & St. Paul.

This company designs to construct a railroad from Red Oak, Iowa, the junction of the Hamburg Branch with the Burlington & Missouri River Railroad, northeast to Mason City, crossing the Rock Island road at Atlantic, the Northwestern at Grand Junction or Jefferson and the Dubuque & Sioux City at Webster City. The distance is something more than 180 miles. It could be used equally well for traffic to and from both St. Paul and Milwaukee. The officers of the company are: President, Col. Hibbard, of Red Oak; Vice-President, J. H. Hager, of Grand Junction; Secretary, F. H. Whitney, of Atlantic; Treasurer, H. N. Moore, of Red Oak.

Atlantic & Pacific.

On the 21st inst. a party of gentlemen, including Mayor Brown and representatives of the Common Council and Board of Trade of St. Louis, together with the President and several directors of this company, left St. Louis for San Francisco to confer with the people of that city concerning the extension of this road to the Pacific.

Kansas City & Lexington Narrow Gauge.

A proposition for Kansas City to subscribe to the stock of this proposed railroad was submitted to a vote recently, but failed to secure the requisite majority. Another vote is spoken of.

This company's branch from St. Louis to Carondelet is nearly completed. At the last annual meeting it was voted to issue $800,000 in real estate bonds to pay for it and other improvements. Hereafter only one-third of the directors will be elected annually, and their terms, therefore, will be for three years.

Missouri Pacific.

The people of Omaha and of the towns in Nebraska on the Missouri south of Omaha, are trying to persuade this company to construct a line up the west side of the Missouri from Rulo to Omaha, to complete a through line from St. Louis to the latter place. The country on the line offers to give the road-bed or subscribe $5,000 per mile if the Missouri Pacific will iron, equip and operate the road. This is especially an Omaha project, as it would give it an outlet which would not reach Council Bluffs. But it is a somewhat circuitous route, the distance being about 485 miles, which, however, is 25 miles longer than by one existing route, and about 40 miles further than by the partly completed (though not now progressing) St. Louis, Council Bluffs & Omaha road.

The amount of road to be built is 87 miles; but this estimate counts on getting the use of the Atchison & Nebraska road from Atchison to Rulo.

The following resolution was adopted by the Missouri Pacific directors relative to the proposition of the Nebraska delegates:

Resolved, That while this board sees and appreciates the great advantages to be derived to the Pacific Railroad and to the city of St. Louis by forming a direct railroad connection with the city of Omaha and the State of Nebraska, still, owing to the fact that this road has just completed and taken charge of two important branches in the past year, viz.: the St. Louis & Lexington Branch, and the St. Louis, Lawrence & Denver Branch, thereby incurring a large outlay, therefore this company does not feel warranted at the present time to undertake the building of more branches or railroad connections; but should the parties in interest at Omaha and surrounding country put their shoulders to the wheel and grade, bridge and tie the proposed road, this company unhesitatingly believe that this or any other company connecting with said proposed road will feel entirely justified in taking, completing and operating said road, thereby furnishing to the State of Nebraska another important outlet for her products, or the Pacific Railroad of Missouri will enter such running arrangements with any parties building or operating said road as cannot but be satisfactory.

American Steamship Company.

This is the company, a majority of whose stock is owned by the Pennsylvania Railroad Company, which is constructing steamships to ply between Philadelphia and Liverpool. At the annual meeting of the stockholders the first annual report was read by the Secretary. It sets forth that the list of subscriptions to the capital stock of the company amounted to 7,047 shares of $100 each, and, according to the Treasurer's report, installments on stock to the amount of $696,020 had been paid, leaving $8,680 yet due on the 30th of August, 1871. Contract since made with Messrs. Cramp for four first-class iron propellers, all to be alike in model and machinery, and the material to be used in their construction, as far as practicable, of American manufacture. Each vessel was to be of 3,016 tons, old measurement; 355 feet in length, 43 feet beam, and furnished with independent, compound, vertical, direct-acting, surface-condensing propelling engines.

They are to be arranged to carry 76 first-class and 854 steerage passengers, and the total cost of the four is to be $2,080,000. The vessels are to be named the "Pennsylvania," to be completed September 1, 1872; "Ohio," to be completed November 1, 1872; "Indiana," to be completed December 1, 1872; and "Illinois," to be completed January 1, 1873. It is expected that the "Pennsylvania" will be launched in June next. Messrs. Cramp & Son give $100,000 security on each vessel for the faithful performance of the contract. One million three hundred and fifty-eight thousand dollars of subscriptions have been received, leaving $142,000 yet due. No plan has yet been decided upon as to how the business of the company shall be conducted when the vessels are ready.

The Treasurer's report sets forth the following: Received on account of installments to stock, $696,020; on account of subscription bonds, $1,358,000; on interest account, $3,175.92; total receipts, $2,157,155.92. William Cramp & Son have been paid to date $617,500, and $1,424,500 have been deposited with the Pennsylvania Railroad Company to secure the fulfillment of the steamship company's contract with these shippers.

The following officers were elected for the ensuing year: President, Herman J. Lombaert. Directors, Edward C. Knight, Washington Butcher, Josiah Bacon, John Rice, B. H. Bartol, John Price Wetherill, Henry D. Welsh, D. B. Cummins, Samuel T. Bodine.

Pittsburgh, Fort Wayne & Chicago.

The President explains the terms of the issue of "special guaranteed stock" of this company. It is to be issued to pay the cost of permanent improvements, such as additional rolling stock or a second track, with these conditions:

"The Pennsylvania Railroad Company shall guarantee the payment, semi-annually or quarterly, thereon, such rate of dividend or interest as may be agreed on to be paid by the Pennsylvania Railroad Company, to the holders thereof, without deduction from the rent therein before named, of $1,380,000 per year, to the holders (being seven per cent.) on the present share capital, and shall be issued only in respect to permanent improvements of and additions to the road, which and the specification of which shall first have been submitted to and approved by the board of directors of the Pittsburgh, Fort Wayne & Chicago Railway Company, in writing, and all such improvements and additions shall be made in such way and manner as may be approved by the said Pittsburgh, Fort Wayne & Chicago Railway Company's board of directors, thus giving the latter company control over the amount of shares to be issued.

"The Pennsylvania Railroad Company guarantees to each holder of this stock to pay dividends on same at rate of seven per cent. per annum, payable quarterly, free of all taxes, and this stock is issued without detriment or prejudice to the general or prior stock, all of which will appear on each share certificate."

President Cass says that the profit of a million and a quarter above the rental during 1871, the constant increase in receipts, and the provision for the funded debt by the sinking fund, which will pay it off by July, 1895, afford a most satisfactory guarantee of the new shares, the proceeds of which, also, will largely increase the earning capacity of the property.

St. Louis & Manchester.

Articles of association of this company have been filed in the office of the Secretary of State of Missouri. It is proposed that the road shall run from St. Louis to or near Manchester, a distance of about twenty miles; and the company have power to construct and operate a branch from or near the junction of Geyer and Big Bend roads in a northerly direction, to unite with any other railroad in or near St. Louis, the length of the proposed road to be about eight miles; capital stock, $300,000.

Hawkinsville & Eufaula.

This company was organized at Americus, Ga., on the 29th ult., $109,000 of stock necessary to organization having been subscribed. The proposed route is from Hawkinsville southwest through Americus and Eufaula, Ala.

Brunswick & Albany.

There is a considerable traffic in lumber on this new road, but the passenger traffic is light, the country on the line being for the most part very thinly settled. Nothing has been done toward the extension of the line from Albany to Eufaula, but the people on the route speak hopefully of it.

Rochester & State Line.

Concerning this railroad project, which is one which the city of Rochester is to be permitted to aid by an issue of bonds, according to a bill pending in the New York Legislature, the Rochester *Union* speaks as follows:

"The bill authorizing this city to aid this road by an exchange of bonds to the amount of $600,000, will, without doubt, receive the signature of the Governor and become a law. Anticipating this, the directors are now maturing and perfecting plans to commence work at once, and it will be pushed forward with energy. It is the intention and purpose of the directors to build the road from this city to Salamanca, and if, in pursuance of this plan, they can make any favorable arrangement by the purchase of any track, or part of a track, on which work has been done, they will do so; but their intention is to construct at the lowest possible sum, and on the most direct and favorable line, all things considered, a railroad direct from this city to Salamanca. As our readers are aware the preliminary survey was made about two years ago, and in the main will probably be followed, and there will be only such departure from it as observation and reflection since may suggest as beneficial to the road and the municipal corporations aiding in its construction."

Utah Northern.

Track is laid for five miles north of Ogden, and tracklaying is progressing rapidly.

The Manufacture of Iron and Steel Rails.*

In order to get an idea as to the strength of steel rails, it will be well to review the tests to which iron rails have been subjected. In England, Mr. Ashcroft found that the best 80 lb. rails broke under a 300 pound weight, falling 15 feet. In Germany the society of railway managers determined on and have long applied a test of 1,000 lb. falling 10½ feet, as the standard which all first-class iron rails must reach. In this country no inspection nor test is applied, but tests made show that iron rails from our most reliable makers break under a 6 foot fall of a 1,500 lb. drop as an extreme test, most of those tested breaking under a far less test; some breaking with less than a 3-foot fall of the same weight.

Everywhere where steel has been used, engineers have come to the conclusion that some test is required to show the regularity and strength of the product. As compared with iron, the tests which steel will stand are wonderful. After numerous experiments partially based on the experience of the rail mill at Gratz, belonging to the Southern Railway of Austria, the society of German railway managers fixed upon a test of 2,000 lb. falling 13½ feet. They found that this test represented the steel which suited their necessities, and also found that with steel of otherwise average purity, this test represented about ½ per cent. of carbon, and made it a rule to take no steel containing under three-tenths of one per cent. of carbon, because it was too soft. They expressed a hope that a harder steel could soon be made tough enough to stand the same test. In England, a test was adopted of 2,240 lb., falling 15 to 17 feet on the rail on heavy bearings. This test has been found satisfactory under heavy traffic on average road-beds, and has been invariably retained by English makers, and adopted by American makers. It is an expeditious practical way of ascertaining the qualities of the rail. Experiment in Germany and experience in England pointed out the test corresponding to the proper grade of steel, and the test adopted has been considered the most practical one. The jar from a moderate weight (2,240 lbs.) falling from a great height is more sudden than that imparted by a heavy weight falling a small distance, and better adapted to exhibit the toughness of the rail. This latter is the object had in view in all tests, as it would take far too long a time to determine the quality of rails by a treatment approximately similar to that received in the track. An objection of some force has been urged against the English method of obtaining test pieces. They take one rail from each day's rolling, to indicate the quality of the rest. In this way their test becomes a matter of chance, and nothing they have yet done has removed this character. Our American practice has been to test every charge, thereby insuring beyond doubt the quality of the rails.

After a short experience with steel rails, it was found that their homogeneity is their distinguishing characteristic; but they unite entire homogeneity with considerable hardness as compared with iron. There are no layers to peel off, no welds to open out, the ends of the rails do not broom out as iron rails do, and the head wears uniformly along its whole length. Not only is the single rail entirely homogeneous, but all the rails made from a single charge have exactly the same qualities. Many experiments on the steel at Seraing in Belgium, in Austria and in this country, before and after its conversion into rails, show this to be a fact.

But the hardness is a most important point as regards wear. Some first-rate English rails have been found too soft for roads with heavy traffic. Therefore, a rail is wanted which will be hard enough to stand abrasion and wear, but strong enough to stand all the strains to which it is liable. The railroad engineer's idea of hardness is that quality which imparts durability without brittleness. Hardness is sometimes erroneously associated with brittleness because some hard bodies are brittle, but in steel brittleness arises from causes entirely different from those which produce hardness. The steel-maker's idea of hardness is a composite one—one that results from considering the effects of physical structure or grain of the steel, and the effects of carbon, phosphorus and manganese. The effects produced by the presence of these elements far exceed any brought about by change of physical structure. Phosphorus and manganese occasion brittleness, while carbon in excess is seldom present, as the processes through which the rail passes have a constant tendency to reduce it. The state in which carbon is present in the rail is, however, remarkably influenced by mechanical treatment and the resulting physical structure. Those modes of reduction which work quickly and forcibly exert a strong influence to retain the carbon in a combined state, while the slower methods on the contrary permit some of the carbon to separate as graphite. These facts have been observed by Gruner and Caron, and have been corroborated in Austrian practice, as the following analysis of steel will show:

(*a*) Steel made for heads of steel rails at Gratz and rolled into shape without hammering:

Combined carbon	0.38	Copper	0.08
Graphite	0 65	Iron	98.57
Silicium	0.05		
Manganese	0.07	Total	99.85
Sulphur	0.05		

(*b*) Steel made at Neuberg and hammered into shape:

Combined carbon	0.234	Manganese	0.139
Graphite	none	Copper	0.105
Silicium	0.033	Iron	99.445
Phosphorus	0.044		
Sulphur	traces	Total	100.

Both these steels were soft Bessemer steel, and from observation I made at the two works on the respective quality of their metal, I see no reason to doubt their correctness. A remarkable point in the matter is that their iron at Neuberg was much more graphitic than that used at Gratz. At Neuberg they tapped direct from the blast furnace, and their "blows" averaged about thirty minutes, some running up to fifty minutes. At Gratz they remelted their iron in an air furnace, and their "blows" were much shorter. The iron each works used was then of substantially the same character, made from charcoal by spathic ore. Neuberg made its own iron, while Gratz bought its iron largely from Mariazell and Eisenerz, furnaces not far from Neuberg.

Now, at the Pennsylvania Steel Works, we have a quite graphitic mixture for conversion, but we find scarcely any graphite at all in the rails—in fact none. Out of many tests we have only one, an apparently abnormal one, in which the graphite amounted to 0.08 per cent., it being generally present in too small quantities to be estimated.

Speaking within the limits of steel manufacture, it is safe to say that brittleness has nothing to do with the mechanical treatment, yet by this treatment the state of the carbon may be controlled and the specific gravity and consequent density of the steel increased. Rails are brittle when too cold-short from the presence of phosphorus and manganese. The proper proportion of the former forms the most delicate point in steel making, and must always be kept within safe limits. No good steel rail has ever yet been made with more than one-fifth of one per cent. of phosphorus, and half that is considered too much by Bessemer. In regard to manganese, our experience is not yet fully ripe. Its action, however, is far less dangerous than that of phosphorus, and in small quantities is beneficial

We have thus a definite idea of the important qualities of steel rails and the proper tests to show their uniformity. The tests made on the steel preclude possibility of brittle steel being used, and it is evident that those methods of reduction which unite the greatest hardness with the necessary strength are to be preferred. In general terms, a steel rail is wanted to last a lifetime, and to be strong enough to stand all accidents of wear.

Railmaking begins with the Bessemer ingot. This is a block of highly crystalline metal, the tensile strength of which is low, and which contains some blow-holes or bubbles formed by the carbonic oxide retained by the liquid steel. The inner surface of these bubbles is generally oxidized, and they are apt to be more numerous near the surface of the ingot.

The first steel rails made ten years ago were treated like cast steel. Until 1863 they were made from ingots seven to eight inches square and four and a half feet long in four heats. In the first two heats the ingot was hammered down to size, one end at a time, and swaged in dies to the shape of the first pass of the rolls. Then the bloom, by this time eight feet long, was rolled in two heats through twelve passes into a finished rail.

This process was excessively crude, wasting everything a steelmaker cares to save, and as the rails were found deficient and their weak points tested, it was found that the small size of the ingots and the little work done on them caused a great number of imperfect rails and a very poor quality in the steel. At this time the expressions of want of confidence in Bessemer steel took shape. We have now, however, surmounted all difficulties, and produced a reliable uniform quality of steel in enormous quantities considered in the light of former capabilities of production. We now use very large ingots, which necessitate thrice the work formerly applied. In 1867 the ingots were raised in England to ten inches square, and in 1870 to twelve inches square, which is the size in general use. In America we have had exactly the English experience with small ingots, the efforts to use them to advantage having entirely failed.

Seeing, then, that large ingots weighing three quarters of a ton, and making two rails, have been found necessary, it has become a question as to what mode of working them up gives the best results. I think that hammering furnishes the preferable product, and my present experience goes to justify the opinion. Rolling is preferred by some makers, because it is thought cheaper, but I think the better wear of a hammered rail is a strong point in its favor. Rolled rails are generally softer than hammered rails, for the reason I have given—namely, because their carbon is apt to be partially separated as graphite, and their density is less.

There have been, in the history of iron metallurgy, two noted contests between rolling and hammering, in one of which the hammer came off victorious, in the other the rolls. I refer to the manufacture of hamm red iron and to that of armor plates. Hammered iron is a necessity for smith work, and the qualities imparted to it by continued piling and hammering are wonderful as compared with ordinary iron. The reputation of the Low-Moor and Yorkshire iron tires and plates is world-wide, and the steel tire had in the Low-Moor tire for some time a formidable competitor. In this case the benefits are produced by a better texture of the iron and greater ductility developed by the work done. The cinder is thoroughly expelled in the blooming and first piling, and may be left out of the question. In the other case the object was to get as soft and wax-like an armor-plate as was consistent with the strength necessary to resist the impact of the shot. As the work done by the shot generally used represents in foot-pounds the effect of one (gross) ton falling a mile and a half, it will readily be acknowledged that there is little similarity between the case of an armor-plate and a steel rail, which has to stand a ton weight falling only 17 feet.

In my own experiments on the effects of the two processes, I compared ingots of the same steel with an average area of respectively about 75 and 110 square inches, average section, as they were the only molds I had at the time to compare. I found that the rails made of blooms, hammered from the ingots of the latter section, stood over 100 per cent. more than the rails made direct from the ingot. The bloom was hammered to the size of the ingot, and each rolled in two heats, one of them a wash heat, into the same kind of rails. I tested in this way 31 different charges. Weight used was 2,000 lbs.; bearings, 2 feet apart. The rails from ingots stood 21½ feet fall of this weight, showing 1 6-10 of an inch deflection without breaking. The rails from the blooms stood a 43 foot fall of the same weight without breaking, and showed a deflection of 3 9-10 inches. This leaves a surplus of 50 per cent. in favor of the hammered rail, deducting 50 per cent. for amount due to difference of area of ingots. To show the connection, on a manufacturing scale, of these tests with the actual result, I would remark that we made 13,285 rails out of the ingots of 75 square inches average area. Of these there were rejected by the railroad, for insufficient strength after delivery, 178 rails, or 1½ per cent. Of the larger ingots we had made, up to the fall of 1870, 32,320 rails, and had rejected for all causes, after delivery, only 18 rails, or 1·20 of one per cent., or a quantity only 1·26 as large as before.

We therefore continued to hammer, but now use an average section of 150 square inches; doing ⅔ the work under the hammer, and only ⅓ in the rolls. Our rails thus produced stand a ton weight falling 17½ feet, and leave an ample margin of reserved strength. We have had recent tests, in which the rail stood what was equivalent to a ton weight falling 70 feet without breaking, but have not yet got up to the armor plate standard of a mile and a half. Out of a lot of 1,200 tons of 58 and 60 lb. rails, not a single rail, out of the 439 tests given, broke under a ton weight falling 16½ feet. We have since had many similar series.

The bubbles in the ingots give some trouble in the subsequent working, sometimes occasioning cracks in the ingot requiring to be chipped out. This we do, as we hammer the ingot down, without hindering the hammer in its work. Rolls are apt to laminate these bubbles instead of forcibly compressing them like the hammer, and it sometimes happens that the bubble breaks out on the surface of the bloom and causes a long streak where the metal is not sound. These streaks are especially noticeable in the head of the rail. In order to obviate the cracks resulting from these blowholes, a hammer must be associated with the rolls to chip out bad places; and this renders the rolling process more complicated than it would appear at first sight. I do not see why it is not simpler to do all the work under one tool, namely the hammer.

The objections to hammering on the score of cutting sharply into the metal are not, in my opinion, of weight, as our experience agrees with the English, that you can hardly have too heavy a hammer for steel. We can strike two full blows of a 12-ton hammer on the same place without deforming or injuring the bloom in any way, or making a mark on it deeper than ⅛ inch each time. As showing what steel will stand, I will say that I have seen, in Vienna, Haswell's hydraulic press reducing ingots from 10 inches thick to 2 inches at one squeeze, without injuring the steel, which was from Neuberg. It is thus surely idle to talk of a hammer as injuring steel in any way. The stroke of a heavy hammer works uniformly through the bloom, drawing the interior as much as the surface. We want to make a hard and tenacious bloom, and the concentrated blow of a heavy hammer is well adapted to that end. We lose practically nothing in ductility as compared with the rolls, and have ample room within the limits of our strength. The chemical composition controls the brittleness of our rails, and as long as we keep that right we can make a comparatively hard rail well adapted to wear.

In regard to the amount produced by the two methods in the same time, the hammer compares very favorably with the rolls. A blooming mill turns out about 55 tons of blooms a day from ingots. We do as much as that daily under a 12-ton hammer, and have done much more than that for a considerable time, so that the relative capacity of the two is hardly decided as yet. In five or six minutes we can hammer down, chip and cut in two, and carry away in large ingots reducing it to one-third its former size; and in thirty-five to forty minutes do the whole work of getting a heat of five ingots hammered complete into finished rail blooms requiring no subsequent hand-chipping. For three months this hammer did an average of about 70 tons of rail blooms per day, turning them out sound and well chipped.

As a matter of interest, it may be well to refer to the fact that at Neuberg, in Styria, they use a 19-ton hammer on steel, and, according to published statements, produce under it in a week only 65 tons out of two furnaces in 11 1-3 turns. They hope by using four furnaces to get up to 130 tons per week. It shows well the spirit of American work to compare our product with this. We do now over three times as much as they hope to do, and do it under a hammer of under two-thirds the weight. The weight of ingots is about the same.

I have explained above my reasons for preferring hammered rails, all derived from experience capable of easy verification. In practice we have found as far as we could compare hammered with rolled rails that the former stand the treatment they have to suffer better than the rolled rails. From experience with rails of different making, rolled and hammered from ingots of the same size, I am enabled to say that the hammered ones have far less rejections on all accounts than the rolled ones, and that their strength against sudden jar is greater.

I believe, therefore, that the hammered rails are superior to the rolled in very important characteristics. I do not deny that rolling may be improved so as to equal a hammered rail. That is not impossible nor improbable. It has not done it yet in my opinion, but when it does I shall be most happy to change my opinion.

In order to show the relative endurance of iron and steel rails, I would like to mention a case that may be regarded as furnishing an American experience of steel rails, equaling that had on the English railroads, and especially on the London and Northwestern. The Philadelphia, Wilmington & Baltimore Railway, laid in their yard in Philadelphia, steel rails on one side of the track and iron rails on the other. The steel rails were hammered rails, and were, with the iron, laid in 1864. The steel rails wore out some 17 sets of the iron rails, and then the company stopped the experiment, laying steel on both sides.

On a curve of 525 feet radius, steel rails have lasted intact since 1865, and are as perfect as when laid, where iron rails had before lasted only from three to six months.

None of the rails of the Pennsylvania Steel Company, nor of any other company in this country, have ever been worn out by traffic or shifting work, so that I can, after a five years' experience of American makes, have reason to believe they will last at least a generation, under the hardest service.

* A paper read before the American Institute of Mining Engineers, at Philadelphia, February 21, by J. B. Pearse, Esq., of the Philadelphia Steel Works.